OM-2226 189783G

April 2002

Processes

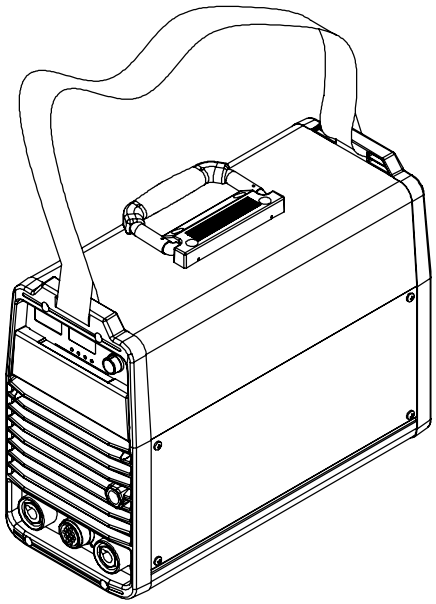
TIG (GTAW) Welding

Stick (SMAW) Welding

Description

115/230/400/460 Volt Models W/Autoline® Arc Welding Power Source

Maxstar® 200 SD, DX, And LX



CE And Non-CE Models

OWNER'S MANUAL

Visit our website at

www.MillerWelds.com

From Miller to You

Thank you and *congratulations* on choosing Miller. Now you can get the job done and get it done right. We know you don't have time to do it any other way.

That's why when Niels Miller first started building arc welders in 1929, he made sure his products offered long-lasting value and superior quality. Like you, his customers couldn't afford anything less. Miller products had to be more than the best they could be. They had to be the best you could buy.

Today, the people that build and sell Miller products continue the tradition. They're just as committed to providing equipment and service that meets the high standards of quality and value established in 1929.

This Owner's Manual is designed to help you get the most out of your Miller products. Please take time to read the Safety precautions. They will help you protect yourself against potential hazards on the worksite. We've made installation and operation quick and easy. With Miller you can count on years of reliable service with proper maintenance. And if for some reason the unit needs repair, there's a Troubleshooting section that will help you figure out what the problem is. The parts list will then help you to decide the exact part you may need to fix the problem. Warranty and service information for your particular model are also provided.

ISO 9001 REGISTERED QUALITY SYSTEM

Miller is the first welding equipment manufacturer in the U.S.A. to be registered to the ISO 9001 Quality System Standard.

Miller Electric manufactures a full line of welders and welding related equipment. For information on other quality Miller products, contact your local Miller distributor to receive the latest full line catalog orindividual catalog sheets. **To locate your nearest distributor or service agency call 1-800-4-A-Miller, or visit us at www.MillerWelds.com on the web.**

TRUE BLUE® WARRANTY

Working as hard as you do – every power source from Miller is backed by the most hassle-free warranty in the business.

Miller offers a Technical Manual which provides more detailed service and parts information for your unit. To obtain a Technical Manual, contact your local distributor. Your distributor can also supply you with Welding Process Manuals such as SMAW, GTAW, GMAW, and GMAW-P.

Miller® *The Power of Blue.*

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⚠ WARNING

This product, when used for welding or cutting, produces fumes or gases which contain chemicals known to the State of California to cause birth defects and, in some cases, cancer. (California Health & Safety Code Section 25249.5 et seq.)

The following terms are used interchangeably throughout this manual:
TIG = GTAW
Stick = SMAW

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OPTIONS AND ACCESSORIES

WARRANTY

Declaration of Conformity For European Community (CE) Products

NOTE ☞	*This information is provided for units with CE certification (see rating label on unit.)*

Manufacturer's Name: Miller Electric Mfg. Co.

Manufacturer's Address: 1635 W. Spencer Street
Appleton, WI 54914 USA

Declares that the product: **Maxstar® 200 SD, DX, LX**

conforms to the following Directives and Standards:

Directives

Low Voltage Directive: 73/23/EEC

Machinery Directives: 89/392/EEC, 91/368/EEC, 93/C 133/04, 93/68/EEC

Electromagnetic Capability Directives: 89/336, 92/31/EEC

Standards

Safety Requirements for Arc Welding Equipment part 1: EN 60974-1: 1990

Arc Welding Equipment Part 1: Welding Power Sources: IEC 974-1 (December 1996 – Draft revision)

Degrees of Protection provided by Enclosures (IP code): IEC 529: 1989

Insulation coordination for equipment within low-voltage systems: Part 1: Principles, requirements and tests: IEC 664-1: 1992

Electromagnetic compatibility (EMC) Product standard for arc welding equipment: EN50199: August 1995

European Contact: Mr. Danilo Fedolfi, Managing Director
MILLER Europe S.r.l.
Via Privata Iseo
20098 San Giuliano
Milanese, Italy

Telephone: 39(02)98290-1
Fax: 39(02)98281-552

SECTION 1 – SAFETY PRECAUTIONS - READ BEFORE USING

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1-1. Symbol Usage

Means Warning! Watch Out! There are possible hazards with this procedure! The possible hazards are shown in the adjoining symbols.

▲ **Marks a special safety message.**

☞ *Means "Note"; not safety related.*

This group of symbols means Warning! Watch Out! possible ELECTRIC SHOCK, MOVING PARTS, and HOT PARTS hazards. Consult symbols and related instructions below for necessary actions to avoid the hazards.

1-2. Arc Welding Hazards

▲ **The symbols shown below are used throughout this manual to call attention to and identify possible hazards. When you see the symbol, watch out, and follow the related instructions to avoid the hazard. The safety information given below is only a summary of the more complete safety information found in the Safety Standards listed in Section 1-4. Read and follow all Safety Standards.**

▲ **Only qualified persons should install, operate, maintain, and repair this unit.**

▲ **During operation, keep everybody, especially children, away.**

ELECTRIC SHOCK can kill.

Touching live electrical parts can cause fatal shocks or severe burns. The electrode and work circuit is electrically live whenever the output is on. The input power circuit and machine internal circuits are also live when power is on. In semiautomatic or automatic wire welding, the wire, wire reel, drive roll housing, and all metal parts touching the welding wire are electrically live. Incorrectly installed or improperly grounded equipment is a hazard.

- Do not touch live electrical parts.
- Wear dry, hole-free insulating gloves and body protection.
- Insulate yourself from work and ground using dry insulating mats or covers big enough to prevent any physical contact with the work or ground.
- Do not use AC output in damp areas, if movement is confined, or if there is a danger of falling.
- Use AC output ONLY if required for the welding process.
- If AC output is required, use remote output control if present on unit.
- Disconnect input power or stop engine before installing or servicing this equipment. Lockout/tagout input power according to OSHA 29 CFR 1910.147 (see Safety Standards).
- Properly install and ground this equipment according to its Owner's Manual and national, state, and local codes.
- Always verify the supply ground – check and be sure that input power cord ground wire is properly connected to ground terminal in disconnect box or that cord plug is connected to a properly grounded receptacle outlet.
- When making input connections, attach proper grounding conductor first – double-check connections.
- Frequently inspect input power cord for damage or bare wiring – replace cord immediately if damaged – bare wiring can kill.
- Turn off all equipment when not in use.
- Do not use worn, damaged, undersized, or poorly spliced cables.
- Do not drape cables over your body.
- If earth grounding of the workpiece is required, ground it directly with a separate cable.
- Do not touch electrode if you are in contact with the work, ground, or another electrode from a different machine.
- Use only well-maintained equipment. Repair or replace damaged parts at once. Maintain unit according to manual.
- Wear a safety harness if working above floor level.
- Keep all panels and covers securely in place.
- Clamp work cable with good metal-to-metal contact to workpiece or worktable as near the weld as practical.
- Insulate work clamp when not connected to workpiece to prevent contact with any metal object.
- Do not connect more than one electrode or work cable to any single weld output terminal.

SIGNIFICANT DC VOLTAGE exists after removal of input power on inverters.

- Turn Off inverter, disconnect input power, and discharge input capacitors according to instructions in Maintenance Section before touching any parts.

FUMES AND GASES can be hazardous.

Welding produces fumes and gases. Breathing these fumes and gases can be hazardous to your health.

- Keep your head out of the fumes. Do not breathe the fumes.
- If inside, ventilate the area and/or use exhaust at the arc to remove welding fumes and gases.
- If ventilation is poor, use an approved air-supplied respirator.
- Read the Material Safety Data Sheets (MSDSs) and the manufacturer's instructions for metals, consumables, coatings, cleaners, and degreasers.
- Work in a confined space only if it is well ventilated, or while wearing an air-supplied respirator. Always have a trained watch-person nearby. Welding fumes and gases can displace air and lower the oxygen level causing injury or death. Be sure the breathing air is safe.
- Do not weld in locations near degreasing, cleaning, or spraying operations. The heat and rays of the arc can react with vapors to form highly toxic and irritating gases.
- Do not weld on coated metals, such as galvanized, lead, or cadmium plated steel, unless the coating is removed from the weld area, the area is well ventilated, and if necessary, while wearing an air-supplied respirator. The coatings and any metals containing these elements can give off toxic fumes if welded.

ARC RAYS can burn eyes and skin.

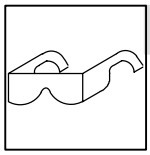
Arc rays from the welding process produce intense visible and invisible (ultraviolet and infrared) rays that can burn eyes and skin. Sparks fly off from the weld.

- Wear a welding helmet fitted with a proper shade of filter to protect your face and eyes when welding or watching (see ANSI Z49.1 and Z87.1 listed in Safety Standards).
- Wear approved safety glasses with side shields under your helmet.
- Use protective screens or barriers to protect others from flash and glare; warn others not to watch the arc.
- Wear protective clothing made from durable, flame-resistant material (leather and wool) and foot protection.

WELDING can cause fire or explosion.

Welding on closed containers, such as tanks, drums, or pipes, can cause them to blow up. Sparks can fly off from the welding arc. The flying sparks, hot workpiece, and hot equipment can cause fires and burns. Accidental contact of electrode to metal objects can cause sparks, explosion, overheating, or fire. Check and be sure the area is safe before doing any welding.

- Protect yourself and others from flying sparks and hot metal.
- Do not weld where flying sparks can strike flammable material.
- Remove all flammables within 35 ft (10.7 m) of the welding arc. If this is not possible, tightly cover them with approved covers.
- Be alert that welding sparks and hot materials from welding can easily go through small cracks and openings to adjacent areas.
- Watch for fire, and keep a fire extinguisher nearby.
- Be aware that welding on a ceiling, floor, bulkhead, or partition can cause fire on the hidden side.
- Do not weld on closed containers such as tanks, drums, or pipes, unless they are properly prepared according to AWS F4.1 (see Safety Standards).
- Connect work cable to the work as close to the welding area as practical to prevent welding current from traveling long, possibly unknown paths and causing electric shock and fire hazards.
- Do not use welder to thaw frozen pipes.
- Remove stick electrode from holder or cut off welding wire at contact tip when not in use.
- Wear oil-free protective garments such as leather gloves, heavy shirt, cuffless trousers, high shoes, and a cap.
- Remove any combustibles, such as a butane lighter or matches, from your person before doing any welding.



FLYING METAL can injure eyes.

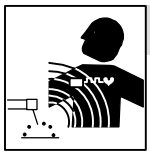
- Welding, chipping, wire brushing, and grinding cause sparks and flying metal. As welds cool, they can throw off slag.
- Wear approved safety glasses with side shields even under your welding helmet.

BUILDUP OF GAS can injure or kill.

- Shut off shielding gas supply when not in use.
- Always ventilate confined spaces or use approved air-supplied respirator.

HOT PARTS can cause severe burns.

- Do not touch hot parts bare handed.
- Allow cooling period before working on gun or torch.



MAGNETIC FIELDS can affect pacemakers.

- Pacemaker wearers keep away.
- Wearers should consult their doctor before going near arc welding, gouging, or spot welding operations.

NOISE can damage hearing.

Noise from some processes or equipment can damage hearing.

- Wear approved ear protection if noise level is high.

CYLINDERS can explode if damaged.

Shielding gas cylinders contain gas under high pressure. If damaged, a cylinder can explode. Since gas cylinders are normally part of the welding process, be sure to treat them carefully.

- Protect compressed gas cylinders from excessive heat, mechanical shocks, slag, open flames, sparks, and arcs.
- Install cylinders in an upright position by securing to a stationary support or cylinder rack to prevent falling or tipping.
- Keep cylinders away from any welding or other electrical circuits.
- Never drape a welding torch over a gas cylinder.
- Never allow a welding electrode to touch any cylinder.
- Never weld on a pressurized cylinder – explosion will result.
- Use only correct shielding gas cylinders, regulators, hoses, and fittings designed for the specific application; maintain them and associated parts in good condition.
- Turn face away from valve outlet when opening cylinder valve.
- Keep protective cap in place over valve except when cylinder is in use or connected for use.
- Read and follow instructions on compressed gas cylinders, associated equipment, and CGA publication P-1 listed in Safety Standards.

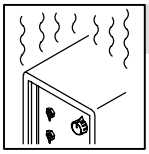
1-3. Additional Symbols For Installation, Operation, And Maintenance

FIRE OR EXPLOSION hazard.

- Do not install or place unit on, over, or near combustible surfaces.
- Do not install unit near flammables.
- Do not overload building wiring – be sure power supply system is properly sized, rated, and protected to handle this unit.

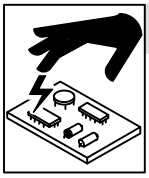
FALLING UNIT can cause injury.

- Use lifting eye to lift unit only, NOT running gear, gas cylinders, or any other accessories.
- Use equipment of adequate capacity to lift and support unit.
- If using lift forks to move unit, be sure forks are long enough to extend beyond opposite side of unit.



OVERUSE can cause OVERHEATING

- Allow cooling period; follow rated duty cycle.
- Reduce current or reduce duty cycle before starting to weld again.
- Do not block or filter airflow to unit.



STATIC (ESD) can damage PC boards.

- Put on grounded wrist strap BEFORE handling boards or parts.
- Use proper static-proof bags and boxes to store, move, or ship PC boards.

MOVING PARTS can cause injury.

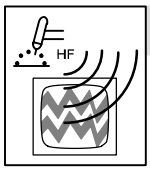
- Keep away from moving parts.
- Keep away from pinch points such as drive rolls.

WELDING WIRE can cause injury.

- Do not press gun trigger until instructed to do so.
- Do not point gun toward any part of the body, other people, or any metal when threading welding wire.

MOVING PARTS can cause injury.

- Keep away from moving parts such as fans.
- Keep all doors, panels, covers, and guards closed and securely in place.



H.F. RADIATION can cause interference.

- High-frequency (H.F.) can interfere with radio navigation, safety services, computers, and communications equipment.
- Have only qualified persons familiar with electronic equipment perform this installation.
- The user is responsible for having a qualified electrician promptly correct any interference problem resulting from the installation.
- If notified by the FCC about interference, stop using the equipment at once.
- Have the installation regularly checked and maintained.
- Keep high-frequency source doors and panels tightly shut, keep spark gaps at correct setting, and use grounding and shielding to minimize the possibility of interference.

ARC WELDING can cause interference.

- Electromagnetic energy can interfere with sensitive electronic equipment such as computers and computer-driven equipment such as robots.
- Be sure all equipment in the welding area is electromagnetically compatible.
- To reduce possible interference, keep weld cables as short as possible, close together, and down low, such as on the floor.
- Locate welding operation 100 meters from any sensitive electronic equipment.
- Be sure this welding machine is installed and grounded according to this manual.
- If interference still occurs, the user must take extra measures such as moving the welding machine, using shielded cables, using line filters, or shielding the work area.

1-4. Principal Safety Standards

Safety in Welding and Cutting, ANSI Standard Z49.1, from American Welding Society, 550 N.W. LeJeune Rd, Miami FL 33126

Safety and Health Standards, OSHA 29 CFR 1910, from Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.

Recommended Safe Practices for the Preparation for Welding and Cutting of Containers That Have Held Hazardous Substances, American Welding Society Standard AWS F4.1, from American Welding Society, 550 N.W. LeJeune Rd, Miami, FL 33126

National Electrical Code, NFPA Standard 70, from National Fire Protection Association, Batterymarch Park, Quincy, MA 02269.

Safe Handling of Compressed Gases in Cylinders, CGA Pamphlet P-1, from Compressed Gas Association, 1235 Jefferson Davis Highway, Suite 501, Arlington, VA 22202.

Code for Safety in Welding and Cutting, CSA Standard W117.2, from Canadian Standards Association, Standards Sales, 178 Rexdale Boulevard, Rexdale, Ontario, Canada M9W 1R3.

Safe Practices For Occupation And Educational Eye And Face Protection, ANSI Standard Z87.1, from American National Standards Institute, 1430 Broadway, New York, NY 10018.

Cutting And Welding Processes, NFPA Standard 51B, from National Fire Protection Association, Batterymarch Park, Quincy, MA 02269.

1-5. EMF Information

Considerations About Welding And The Effects Of Low Frequency Electric And Magnetic Fields

Welding current, as it flows through welding cables, will cause electromagnetic fields. There has been and still is some concern about such fields. However, after examining more than 500 studies spanning 17 years of research, a special blue ribbon committee of the National Research Council concluded that: “The body of evidence, in the committee’s judgment, has not demonstrated that exposure to power-frequency electric and magnetic fields is a human-health hazard.” However, studies are still going forth and evidence continues to be examined. Until the final conclusions of the research are reached, you may wish to minimize your exposure to electromagnetic fields when welding or cutting.

To reduce magnetic fields in the workplace, use the following procedures:

1. Keep cables close together by twisting or taping them.
2. Arrange cables to one side and away from the operator.
3. Do not coil or drape cables around your body.
4. Keep welding power source and cables as far away from operator as practical.
5. Connect work clamp to workpiece as close to the weld as possible.

About Pacemakers:

Pacemaker wearers consult your doctor first. If cleared by your doctor, then following the above procedures is recommended.

SECTION 1 – CONSIGNES DE SECURITE – LIRE AVANT UTILISATION

1-1. Signification des symboles

Signifie Mise en garde ! Soyez vigilant ! Cette procédure présente des risques de danger ! Ceux-ci sont identifiés par des symboles adjacents aux directives.

▲ **Identifie un message de sécurité particulier.**

☞ *Signifie NOTA ; n'est pas relatif à la sécurité.*

Ce groupe de symboles signifie Mise en garde ! Soyez vigilant ! Il y a des risques de danger reliés aux CHOCS ÉLECTRIQUES, aux PIÈCES EN MOUVEMENT et aux PIÈCES CHAUDES. Reportez-vous aux symboles et aux directives ci-dessous afin de connaître les mesures à prendre pour éviter tout danger.

1-2. Dangers relatifs au soudage à l'arc

▲ **Les symboles présentés ci-après sont utilisés tout au long du présent manuel pour attirer votre attention et identifier les risques de danger. Lorsque vous voyez un symbole, soyez vigilant et suivez les directives mentionnées afin d'éviter tout danger. Les consignes de sécurité présentées ci-après ne font que résumer l'information contenue dans les normes de sécurité énumérées à la section 1-4. Veuillez lire et respecter toutes ces normes de sécurité.**

▲ **L'installation, l'utilisation, l'entretien et les réparations ne doivent être confiés qu'à des personnes qualifiées.**

▲ **Au cours de l'utilisation, tenir toute personne à l'écart et plus particulièrement les enfants.**

UN CHOC ÉLECTRIQUE peut tuer.

Un simple contact avec des pièces électriques peut provoquer une électrocution ou des blessures graves. L'électrode et le circuit de soudage sont sous tension dès que l'appareil est sur ON. Le circuit d'entrée et les circuits internes de l'appareil sont également sous tension à ce moment-là. En soudage semi-automatique ou automatique, le fil, le dévidoir, le logement des galets d'entraînement et les pièces métalliques en contact avec le fil de soudage sont sous tension. Des matériels mal installés ou mal mis à la terre présentent un danger.

- Ne jamais toucher les pièces électriques sous tension.
- Porter des gants et des vêtements de protection secs ne comportant pas de trous.
- S'isoler de la pièce et de la terre au moyen de tapis ou d'autres moyens isolants suffisamment grands pour empêcher le contact physique éventuel avec la pièce ou la terre.
- Ne pas se servir de source électrique àcourant électrique dans les zones humides, dans les endroits confinés ou là où on risque de tomber.
- Se servir d'une source électrique àcourant électrique UNIQUEMENT si le procédé de soudage le demande.
- Si l'utilisation d'une source électrique àcourant électrique s'avère nécessaire, se servir de la fonction de télécommande si l'appareil en est équipé.
- Couper l'alimentation ou arrêter le moteur avant de procéder à l'installation, à la réparation ou à l'entretien de l'appareil. Déverrouiller l'alimentation selon la norme OSHA 29 CFR 1910.147 (voir normes de sécurité).
- Installer et mettre à la terre correctement cet appareil conformément à son manuel d'utilisation et aux codes nationaux, provinciaux et municipaux.
- Toujours vérifier la terre du cordon d'alimentation – Vérifier et s'assurer que le fil de terre du cordon d'alimentation est bien raccordé à la borne de terre du sectionneur ou que la fiche du cordon est raccordée à une prise correctement mise à la terre.
- En effectuant les raccordements d'entrée fixer d'abord le conducteur de mise à la terre approprié et contre-vérifier les connexions.
- Vérifier fréquemment le cordon d'alimentation pour voir s'il n'est pas endommagé ou dénudé – remplacer le cordon immédiatement s'il est endommagé – un câble dénudé peut provoquer une électrocution.
- Mettre l'appareil hors tension quand on ne l'utilise pas.
- Ne pas utiliser des câbles usés, endommagés, de grosseur insuffisante ou mal épissés.
- Ne pas enrouler les câbles autour du corps.
- Si la pièce soudée doit être mise à la terre, le faire directement avec un câble distinct.
- Ne pas toucher l'électrode quand on est en contact avec la pièce, la terre ou une électrode provenant d'une autre machine.
- N'utiliser qu'un matériel en bon état. Réparer ou remplacer sur-le-champ les pièces endommagées. Entretenir l'appareil conformément à ce manuel.
- Porter un harnais de sécurité quand on travaille en hauteur.
- Maintenir solidement en place tous les panneaux et capots.
- Fixer le câble de retour de façon à obtenir un bon contact métal-métal avec la pièce à souder ou la table de travail, le plus près possible de la soudure.
- Isoler la pince de masse quand pas mis à la pièce pour éviter le contact avec tout objet métallique.

Il y a DU COURANT CONTINU IMPORTANT dans les convertisseurs après la suppression de l'alimentation électrique.

- Arrêter les convertisseurs, débrancher le courant électrique, et décharger les condensateurs d'alimentation selon les instructions indiquées dans la partie entretien avant de toucher les pièces.

LES FUMÉES ET LES GAZ peuvent être dangereux.

Le soudage génère des fumées et des gaz. Leur inhalation peut être dangereux pour votre santé.

- Eloigner votre tête des fumées. Ne pas respirer les fumées.
- A l'intérieur, ventiler la zone et/ou utiliser un échappement au niveau de l'arc pour l'évacuation des fumées et des gaz de soudage.
- Si la ventilation est insuffisante, utiliser un respirateur à alimentation d'air homologué.
- Lire les spécifications de sécurité des matériaux (MSDSs) et les instructions du fabricant concernant les métaux, les consommables, les revêtements, les nettoyants et les dégraisseurs.
- Travailler dans un espace fermé seulement s'il est bien ventilé ou en portant un respirateur à alimentation d'air. Demander toujours à un surveillant dûment formé de se tenir à proximité. Des fumées et des gaz de soudage peuvent déplacer l'air et abaisser le niveau d'oxygène provoquant des blessures ou des accidents mortels. S'assurer que l'air de respiration ne présente aucun danger.
- Ne pas souder dans des endroits situés à proximité d'opérations de dégraissage, de nettoyage ou de pulvérisation. La chaleur et les rayons de l'arc peuvent réagir en présence de vapeurs et former des gaz hautement toxiques et irritants.
- Ne pas souder des métaux munis d'un revêtement, tels que l'acier galvanisé, plaqué en plomb ou au cadmium à moins que le revêtement n'ait été enlevé dans la zone de soudure, que l'endroit soit bien ventilé, et si nécessaire, en portant un respirateur à alimentation d'air. Les revêtements et tous les métaux renfermant ces éléments peuvent dégager des fumées toxiques en cas de soudage.

LES RAYONS DE L'ARC peuvent provoquer des brûlures dans les yeux et sur la peau.

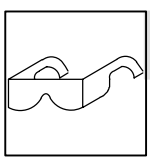
Le rayonnement de l'arc du procédé de soudage génère des rayons visibles et invisibles intenses (ultraviolets et infrarouges) susceptibles de provoquer des brûlures dans les yeux et sur la peau. Des étincelles sont projetées pendant le soudage.

- Porter un casque de soudage muni d'un écran de filtre approprié pour protéger votre visage et vos yeux pendant le soudage ou pour regarder (voir ANSI Z49.1 et Z87.1 énuméré dans les normes de sécurité).
- Porter des protections approuvés pour les oreilles si le niveau sondre est trop élevé.
- Utiliser des écrans ou des barrières pour protéger des tiers de l'éclair et de l'éblouissement; demander aux autres personnes de ne pas regarder l'arc.
- Porter des vêtements de protection constitué dans une matière durable, résistant au feu (cuir ou laine) et une protection des pieds.

LE SOUDAGE peut provoquer un incendie ou une explosion.

Le soudage effectué sur des conteneurs fermés tels que des réservoirs, tambours ou des conduites peut provoquer leur éclatement. Des étincelles peuvent être projetées de l'arc de soudure. La projection d'étincelles, des pièces chaudes et des équipements chauds peut provoquer des incendies et des brûlures. Le contact accidentel de l'électrode avec des objets métalliques peut provoquer des étincelles, une explosion, un surchauffement ou un incendie. Avant de commencer le soudage, vérifier et s'assurer que l'endroit ne présente pas de danger.

- Se protéger et d'autres personnes de la projection d'étincelles et de métal chaud.
- Ne pas souder dans un endroit là où des étincelles peuvent tomber sur des substances inflammables.
- Déplacer toutes les substances inflammables à une distance de 10,7 m de l'arc de soudage. En cas d'impossibilité les recouvrir soigneusement avec des protections homologués.
- Des étincelles et des matériaux chauds du soudage peuvent facilement passer dans d'autres zones en traversant de petites fissures et des ouvertures.
- Surveiller tout déclenchement d'incendie et tenir un extincteur à proximité.
- Le soudage effectué sur un plafond, plancher, paroi ou séparation peut déclencher un incendie de l'autre côté.
- Ne pas effectuer le soudage sur des conteneurs fermés tels que des réservoirs, tambours, ou conduites, à moins qu'ils n'aient été préparés correctement conformément à AWS F4.1 (voir les normes de sécurité).
- Brancher le câble sur la pièce le plus près possible de la zone de soudage pour éviter le transport du courant sur une longue distance par des chemins inconnus éventuels en provoquant des risques d'électrocution et d'incendie.
- Ne pas utiliser le poste de soudage pour dégeler des conduites gelées.
- En cas de non utilisation, enlever la baguette d'électrode du porte-électrode ou couper le fil à la pointe de contact.
- Porter des vêtements de protection dépourvus d'huile tels que des gants en cuir, une chemise en matériau lourd, des pantalons sans revers, des chaussures hautes et un couvre chef.
- Avant de souder, retirer toute substance combustible de vos poches telles qu'un allumeur au butane ou des allumettes.



DES PARTICULES VOLANTES peuvent blesser les yeux.

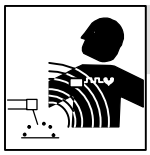
- Le soudage, l'écaillement, le passage de la pièce à la brosse en fil de fer, et le meulage génèrent des étincelles et des particules métalliques volantes. Pendant la période de refroidissement des soudures, elles risquent de projeter du laitier.
- Porter des lunettes de sécurité avec écrans latéraux ou un écran facial.

LES ACCUMULATIONS DE GAZ risquent de provoquer des blessures ou même la mort.

- Fermer l'alimentation du gaz protecteur en cas de non utilisation.
- Veiller toujours à bien aérer les espaces confinés ou se servir d'un respirateur d'adduction d'air homologué.

DES PIÈCES CHAUDES peuvent provoquer des brûlures graves.

- Ne pas toucher des parties chaudes à mains nues
- Prévoir une période de refroidissement avant d'utiliser le pistolet ou la torche.



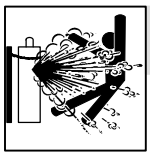
LES CHAMPS MAGNÉTIQUES peuvent affecter les stimulateurs cardiaques.

- Porteurs de stimulateur cardiaque, restez à distance.
- Les porteurs d'un stimulateur cardiaque doivent d'abord consulter leur médecin avant de s'approcher des opérations de soudage à l'arc, de gougeage ou de soudage par points.

LE BRUIT peut affecter l'ouïe.

Le bruit des processus et des équipements peut affecter l'ouïe.

- Porter des protections approuvés pour les oreilles si le niveau sondre est trop élevé.



Si des BOUTEILLES sont endommagées, elles pourront exploser.

Des bouteilles de gaz protecteur contiennent du gaz sous haute pression. Si une bouteille est endommagée, elle peut exploser. Du fait que les bouteilles de gaz font normalement partie du procédé de soudage, les manipuler avec précaution.

- Protéger les bouteilles de gaz comprimé d'une chaleur excessive, des chocs mécaniques, du laitier, des flammes ouvertes, des étincelles et des arcs.
- Placer les bouteilles debout en les fixant dans un support stationnaire ou dans un porte-bouteilles pour les empêcher de tomber ou de se renverser.
- Tenir les bouteilles éloignées des circuits de soudage ou autres circuits électriques.
- Ne jamais placer une torche de soudage sur une bouteille à gaz.
- Une électrode de soudage ne doit jamais entrer en contact avec une bouteille.
- Ne jamais souder une bouteille pressurisée – risque d'explosion.
- Utiliser seulement des bouteilles de gaz protecteur, régulateurs, tuyaux et raccords convenables pour cette application spécifique; les maintenir ainsi que les éléments associés en bon état.
- Ne pas tenir la tête en face de la sortie en ouvrant la soupape de la bouteille.
- Maintenir le chapeau de protection sur la soupape, sauf en cas d'utilisation ou de branchement de la bouteille.
- Lire et suivre les instructions concernant les bouteilles de gaz comprimé, les équipements associés et les publications P-1 CGA énumérées dans les normes de sécurité.

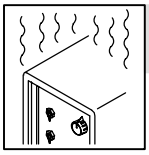
1-3. Dangers supplémentaires en relation avec l'installation, le fonctionnement et la maintenance

Risque D'INCENDIE OU D'EXPLOSION.

- Ne pas placer l'appareil sur, au-dessus ou à proximité de surfaces infllammables.
- Ne pas installer l'appareil à proximité de produits inflammables
- Ne pas surcharger l'installation électrique – s"assurer que l'alimentation est correctement dimensionné et protégé avant de mettre l'appareil en service.

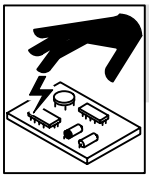
LA CHUTE DE L'APPAREIL peut blesser.

- Utiliser l'anneau de levage uniquement pour soulever l'appareil, NON PAS les chariot, les bouteilles de gaz ou tout autre accessoire.
- Utiliser un engin d'une capacité appropriée pour soulever l'appareil.
- En utilisant des fourches de levage pour déplacer l'unité, s'assurer que les fourches sont suffisamment longues pour dépasser du côté opposé de l'appareil.



L'EMPLOI EXCESSIF peut SURCHAUFFER L'ÉQUIPEMENT.

- Prévoir une période de refroidissement, respecter le cycle opératoire nominal.
- Réduire le courant ou le cycle opératoire avant de recommancer le soudage.
- Ne pas obstruer les passages d'air du poste.



LES CHARGES ÉLECTROSTATIQUES peuvent endommager les circuits imprimés.

- Établir la connexion avec la barrette de terre avant de manipuler des cartes ou des pièces.
- Utiliser des pochettes et des boîtes antistatiques pour stocker, déplacer ou expédier des cartes de circuits imprimes.

DES ORGANES MOBILES peuvent provoquer des blessures.

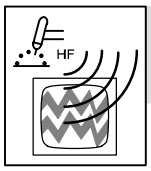
- Ne pas s'approcher des organes mobiles.
- Ne pas s'approcher des points de coincement tels que des rouleaux de commande.

LES FILS DE SOUDAGE peuvent provoquer des blessures.

- Ne pas appuyer sur la gachette avant d'en avoir reçu l'instruction.
- Ne pas diriger le pistolet vers soi, d'autres personnes ou toute pièce mécanique en engageant le fil de soudage.

DES ORGANES MOBILES peuvent provoquer des blessures.

- Rester à l'écart des organes mobiles comme le ventilateur.
- Maintenir fermés et fixement en place les portes, panneaux, recouvrements et dispositifs de protection.



LE RAYONNEMENT HAUTE FRÉQUENCE (H.F.) risque de provoquer des interférences.

- Le rayonnement haute frequence peut provoquer des interférences avec les équipements de radio–navigation et de communication, les services de sécurité et les ordinateurs.
- Demander seulement à des personnes qualifiées familiarisées avec des équipements électroniques de faire fonctionner l'installation.
- L'utilisateur est tenu de faire corriger rapidement par un électricien qualifié les interférences résultant de l'installation.
- Si le FCC signale des interférences, arrêter immédiatement l'appareil.
- Effectuer régulièrement le contrôle et l'entretien de l'installation.
- Maintenir soigneusement fermés les portes et les panneaux des sources de haute fréquence, maintenir les éclateurs à une distance correcte et utiliser une terre et et un blindage pour réduire les interférences éventuelles.

LE SOUDAGE À L'ARC risque de provoquer des interférences.

- L'énergie électromagnétique risque de provoquer des interférences pour l'équipement électronique sensible tel que les ordinateurs et l'équipement commandé par ordinateur tel que les robots.
- Veiller à ce que tout l'équipement de la zone de soudage soit compatible électromagnétiquement.
- Pour réduire la possibilité d'interférence, maintenir les câbles de soudage aussi courts que possible, les grouper, et les poser aussi bas que possible (ex. par terre).
- Veiller à souder à une distance de 100 mètres de tout équipement électronique sensible.
- Veiller à ce que ce poste de soudage soit posé et mis à la terre conformément à ce mode d'emploi.
- En cas d'interférences après avoir pris les mesures précédentes, il incombe à l'utilisateur de prendre des mesures supplémentaires telles que le déplacement du poste, l'utilisation de câbles blindés, l'utilisation de filtres de ligne ou la pose de protecteurs dans la zone de travail.

LES CHAMPS MAGNÉTIQUES peuvent affecter les stimulateurs cardiaques.

- Porteurs de stimulateur cardiaque, restez à distance.
- Les porteurs d'un stimulateur cardiaque doivent d'abord consulter leur médecin avant de s'approcher des opérations de soudage à l'arc, de gougeage ou de soudage par points.

1-4. Principales normes de sécurité

Safety in Welding and Cutting, norme ANSI Z49.1, de l'American Welding Society, 550 N.W. Lejeune Rd, Miami FL 33126

Safety and Health Sandards, OSHA 29 CFR 1910, du Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.

Recommended Safe Practice for the Preparation for Welding and Cutting of Containers That Have Held Hazardous Substances, norme AWS F4.1, de l'American Welding Society, 550 N.W. Lejeune Rd, Miami FL 33126

National Electrical Code, NFPA Standard 70, de la National Fire Protection Association, Batterymarch Park, Quincy, MA 02269.

Safe Handling of Compressed Gases in Cylinders, CGA Pamphlet P-1, de la Compressed Gas Association, 1235 Jefferson Davis Highway, Suite 501, Arlington, VA 22202.

Règles de sécurité en soudage, coupage et procédés connexes, norme CSA W117.2, de l'Association canadienne de normalisation, vente de normes, 178 Rexdale Boulevard, Rexdale (Ontario) Canada M9W 1R3.

Safe Practices For Occupation And Educational Eye And Face Protection, norme ANSI Z87.1, de l'American National Standards Institute, 1430 Broadway, New York, NY 10018.

Cutting and Welding Processes, norme NFPA 51B, de la National Fire Protection Association, Batterymarch Park, Quincy, MA 02269.

1-5. Information sur les champs électromagnétiques

Données sur le soudage électrique et sur les effets, pour l'organisme, des champs magnétiques basse fréquence

Le courant de soudage, pendant son passage dans les câbles de soudage, causera des champs électromagnétiques. Il y a eu et il y a encore un certain souci à propos de tels champs. Cependant, après avoir examiné plus de 500 études qui ont été faites pendant une période de recherche de 17 ans, un comité spécial ruban bleu du National Research Council a conclu: "L'accumulation de preuves, suivant le jugement du comité, n'a pas démontré que l'exposition aux champs magnétiques et champs électriques à haute fréquence représente un risque à la santé humaine". Toutefois, des études sont toujours en cours et les preuves continuent à être examinées. En attendant que les conclusions finales de la recherche soient établies, il vous serait souhaitable de réduire votre exposition aux champs électromagnétiques pendant le soudage ou le coupage.

Afin de réduire les champs électromagnétiques dans l'environnement de travail, respecter les consignes suivantes :

1 Garder les câbles ensembles en les torsadant ou en les attachant avec du ruban adhésif.

2 Mettre tous les câbles du côté opposé de l'opérateur.

3 Ne pas courber pas et ne pas entourer pas les câbles autour de votre corps.

4 Garder le poste de soudage et les câbles le plus loin possible de vous.

5 Relier la pince de masse le plus près possible de la zone de soudure.

Consignes relatives aux stimulateurs cardiaques :

Les personnes qui portent un stimulateur cardiaque doivent avant tout consulter leur docteur. Si vous êtes déclaré apte par votre docteur, il est alors recommandé de respecter les consignes ci–dessus.

SECTION 2 – DEFINITIONS (CE Models)

2-1. Warning Label Definitions

Warning! Watch Out! There are possible hazards as shown by the symbols.

1 Electric shock from welding electrode or wiring can kill.

1.1 Wear dry insulating gloves. Do not touch electrode with bare hand. Do not wear wet or damaged gloves.

1.2 Protect yourself from electric shock by insulating yourself from work and ground.

1.3 Disconnect input plug or power before working on machine.

2 Breathing welding fumes can be hazardous to your health.

2.1 Keep your head out of the fumes.

2.2 Use forced ventilation or local exhaust to remove the fumes.

2.3 Use ventilating fan to remove fumes.

3 Welding sparks can cause explosion or fire.

3.1 Keep flammables away from welding. Do not weld near flammables.

3.2 Welding sparks can cause fires. Have a fire extinguisher nearby, and have a watchperson ready to use it.

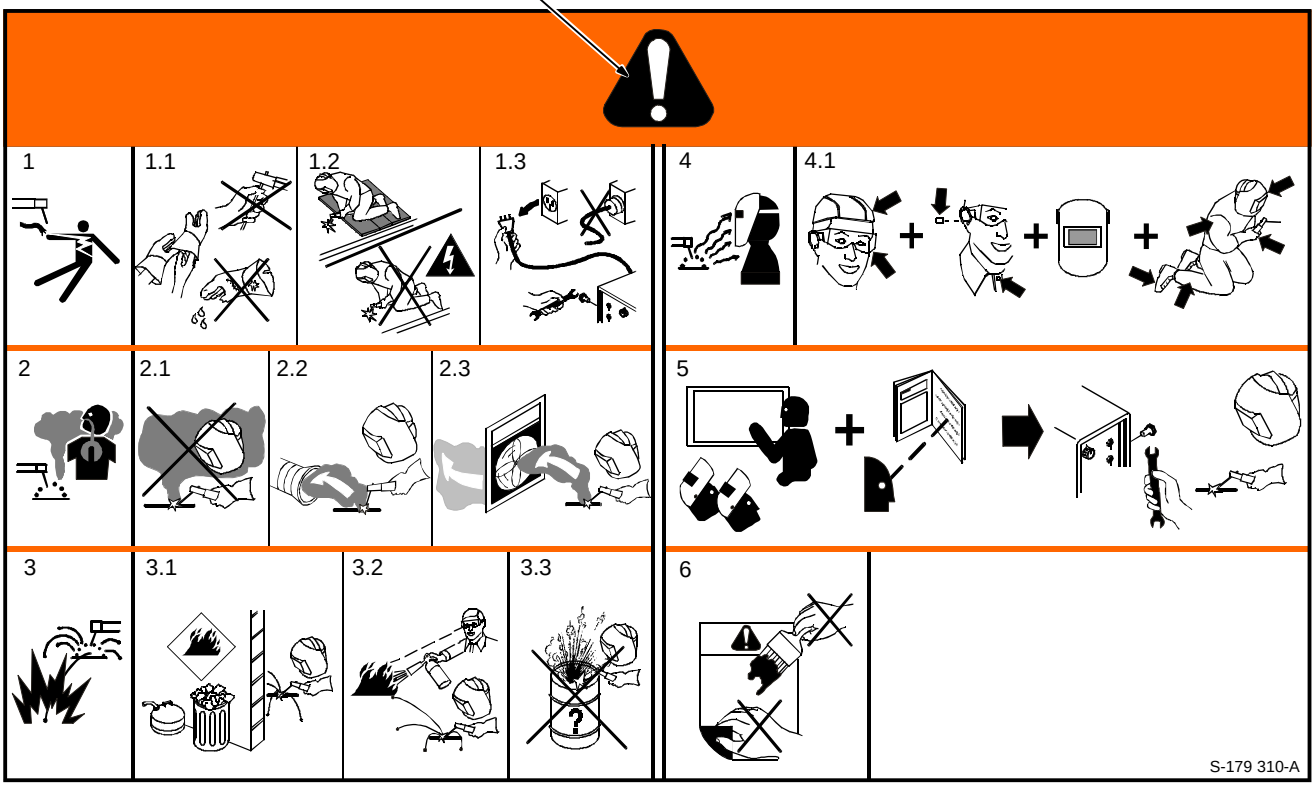
3.3 Do not weld on drums or any closed containers.

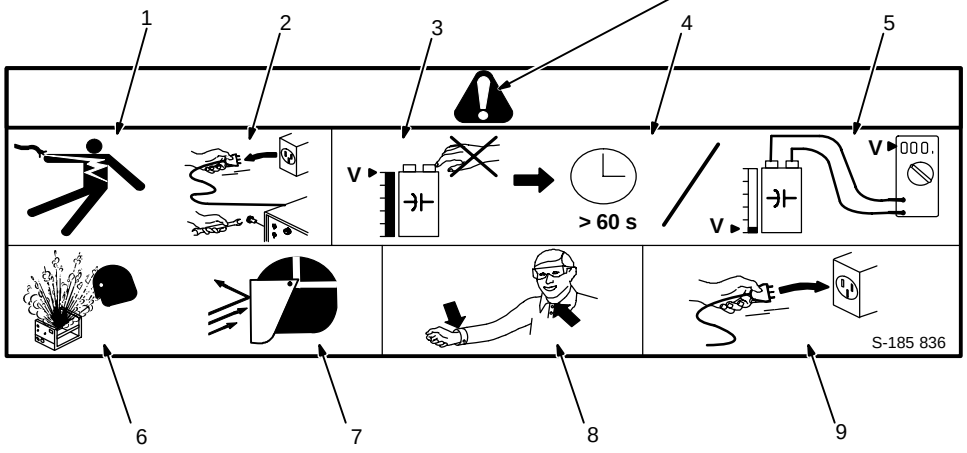
4 Arc rays can burn eyes and injure skin.

4.1 Wear hat and safety glasses. Use ear protection and button shirt collar. Use welding helmet with correct shade of filter. Wear complete body protection.

5 Become trained and read the instructions before working on the machine or welding.

6 Do not remove or paint over (cover) the label.





Warning! Watch Out! There are possible hazards as shown by the symbols.

1 Electric shock from wiring can kill.

2 Disconnect input plug or power before working on machine.

3 Hazardous voltage remains on input capacitors after power is turned off. Do not touch fully charged capacitors.

4 Always wait 60 seconds after power is turned off before working on unit, OR

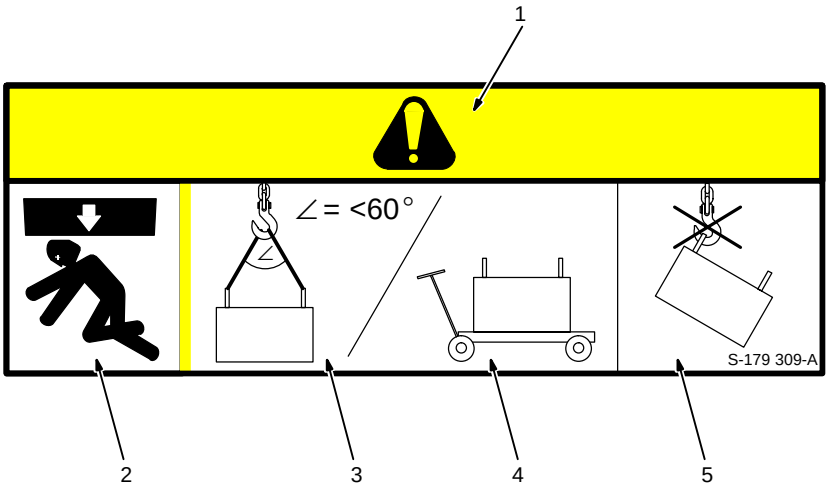
5 Check input capacitor voltage, and be sure it is near 0 before touching any parts.

6 When power is applied failed parts can explode or cause other parts to explode.

7 Flying pieces of parts can cause injury. Always wear a face shield when servicing unit.

8 Always wear long sleeves and button your collar when servicing unit.

9 After taking proper precautions as shown, connect power to unit.



1 Warning! Watch Out! There are possible hazards as shown by the symbols.

2 Falling equipment can cause injury and damage to unit.

3 Always lift and support unit using both handles. Keep angle of lifting device less than 60 degrees.

4 Use a proper cart to move unit.

5 Do not use one handle to lift or support unit.

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2-2. Manufacturer's Rating Label

☞ *See Section 3-4 for location.*

☞ *Use rating label to determine input power requirements.*

				EN 60974–1			
S	1A 10V				200A 18V	U_1 =115V	
		X	40%	60%	100%	70%	100%
		I_2	200	175	150	150	125
	U_o 80V	U_2	18	17	16	16	15
S	1A 20V				200A 28V	U_1 =115V	
		X	40%	60%	100%	50%	80%
		I_2	175	150	125	125	100
	U_o 80V	U_2	27	26	25	25	24
				I_1 max		I_1 eff	
1 ~ 50/60 Hz		U_1 =115V		35		25	
1 ~ 50/60 Hz		U_1 =230V		31		17	
3 ~ 50/60 Hz		U_1 =230V		19		11	
3 ~ 50/60 Hz		U_1 =400V		11		6	
3 ~ 50/60 Hz		U_1 =460V		9		5	
		IP23					

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2-3. Symbols And Definitions

A Amperes	Panel–Local	Gas Tungsten Arc Welding (GTAW)	Shielded Metal Arc Welding (SMAW)
V Volts	Voltage Input	3 Phase Static Frequency Converter-Transformer-Rectifier	
Voltage Output	Circuit Breaker	Remote	Lift-Arc Start (GTAW)
Protective Earth (Ground)	Postflow Timer	Preflow Timer	S Seconds
On	Off	Positive	Negative
Alternating Current	Gas Input	Gas Output	I_2 Rated Welding Current
X Duty Cycle	Direct Current	Line Connection	U_2 Conventional Load Voltage
U_1 Primary Voltage	IP Degree Of Protection	I_{1max} Rated Maximum Supply Current	I_{1eff} Maximum Effective Supply Current
U_0 Rated No Load Voltage (Average)	Pulse Background Amperage	Initial Amperage	Increase/Decrease Of Quantity
Normal Trigger Operation (GTAW)	Two-Step Trigger Operation (GTAW)	Four-Step Trigger Operation (GTAW)	% Percent
Hz Hertz	Recall From Memory	Arc Force (DIG)	HF Impulse Starting (GTAW)
Final Slope	Final Amperage	Pulse Percent On Time	Initial Slope
Contactor Control (Stick)	Pulser On-Off	TIG Weld Amps And Peak Amps While Pulsing	Pulse Frequency
Background Amps	Process	Pulser	Sequence
Output	Adjust	Suitable For Areas Of Increased Shock Hazard	

SECTION 3 – INSTALLATION

3-1. Specifications

Input Power	Rated Output	Welding Amperage Range	Max. Open-Circuit Voltage	Amperes Input At Rated Output, 50/60Hz				KVA	KW
				115	230	400	460		
Three-Phase Stick Process	150 A @ 26 VDC, 60% Duty Cycle	1 – 200	80 9-14♦	-–	13.1 0.16*	7.4 0.24*	6.4 0.25*	5.2 0.06*	5.0 0.03*
Three-Phase TIG Process	175 A @ 17 VDC, 60% Duty Cycle	1 – 200	80 9-14♦	-–	10.5 0.16*	6.0 0.24*	5.2 0.25*	4.2 0.06*	4.0 0.03*
Three-Phase Stick Process	200 A @ 28 VDC, 30% Duty Cycle	1 – 200	80 9-14♦		18.4 0.16*	10.3 0.24*	8.9 0.25*	7.3 0.06*	7.0 0.03*
Three-Phase TIG Process	200 A @ 18 VDC, 40% Duty Cycle	1 – 200	80 9-14♦		12.7 0.16*	7.2 0.24*	6.2 0.25*	5.1 0.06*	4.9 0.03*
Single-Phase Stick Process	150 A @ 26 VDC, 60% Duty Cycle	1 – 200	80 9-14♦	-–	21.7 0.23*	-–	10.6 .25*	5.0 0.05*	5.0 0.02*
Single-Phase TIG Process	175 A @ 17 VDC, 60% Duty Cycle	1 – 200	80 9-14♦	-–	17.4 0.23*	-–	8.5 .25*	4.0 0.05*	4.0 0.02*
Single-Phase Stick Process	125 A @ 25 VDC, 50% Duty Cycle	1 – 200	80 9-14♦	34.1 0.42*	-–	-–	-–	4.0 0.05*	3.8 0.03*
Single-Phase TIG Process	150 A @ 16 VDC, 70% Duty Cycle	1 – 200	80 9-14♦	29.7 0.42*	-–	-–	-–	3.4 0.05*	3.4 0.03*
Single-Phase Stick Process	100 A @ 24 VDC, 80% Duty Cycle	1 – 200	80 9-14♦	28.1 0.42*	-–	-–	-–	3.2 0.05*	3.2 0.03*
Single-Phase TIG Process	125 A @ 15 VDC, 100% Duty Cycle	1 – 200	80 9-14♦	23.0 0.42*	-–	-–	-–	2.6 0.05*	2.6 0.03*

*While idling

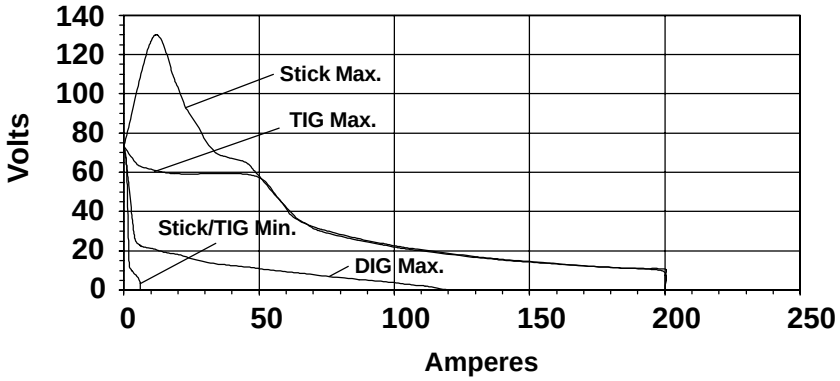
♦ Sense Voltage For Stick And TIG Lift Arc™

NOTE: Duty cycle limitations on units with 115 volt input power are due to the input power cord supplied with the unit.

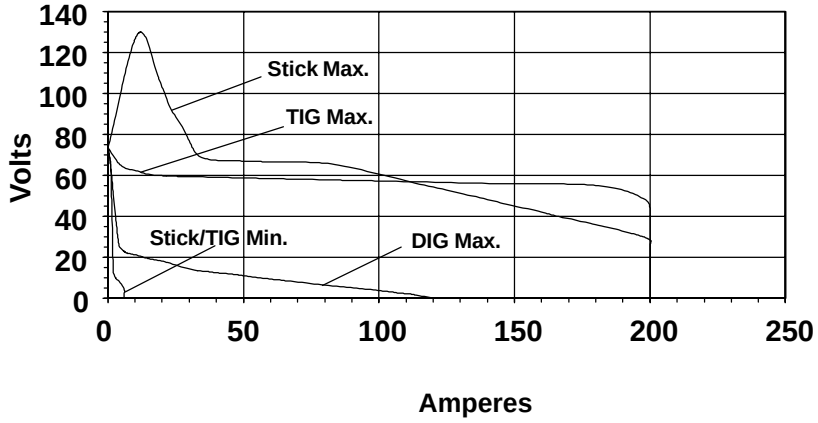
3-2. Volt-Ampere Curves

Volt-ampere curves show minimum and maximum voltage and amperage output capabilities of welding power source. Curves of other settings fall between curves shown.

115VAC Input



Other Input Voltages



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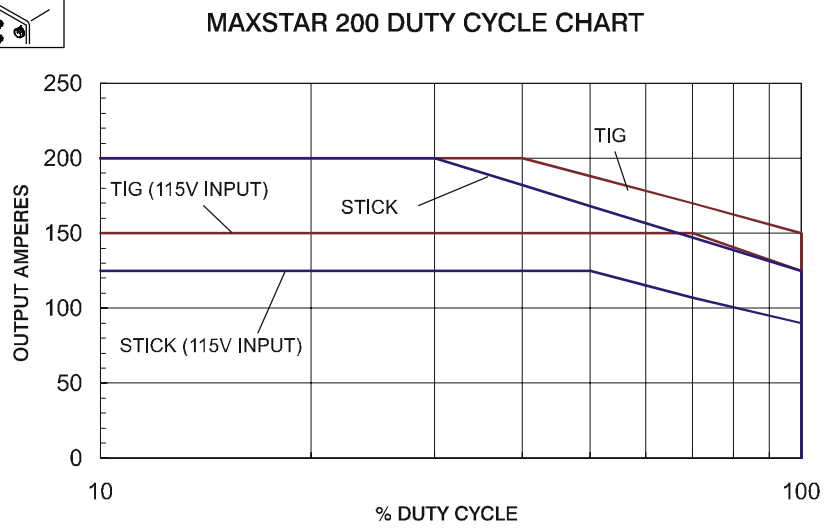
3-3. Duty Cycle And Overheating



Duty Cycle is percentage of 10 minutes that unit can weld at rated load without overheating.

If unit overheats, output stops, a Help message is displayed (see Section 5-3), and cooling fan runs. Wait fifteen minutes for unit to cool. Reduce amperage or voltage, or duty cycle before welding.

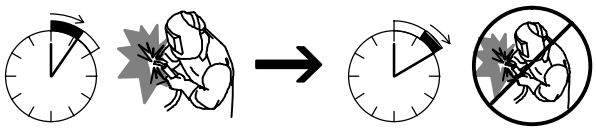
▲ **Exceeding duty cycle can damage unit and void warranty.**

90 A @ 100% Duty Cycle For 115 Volt Single-Phase Stick Process

125 A @ 100% Duty Cycle For 115 Volt Single-Phase TIG Process

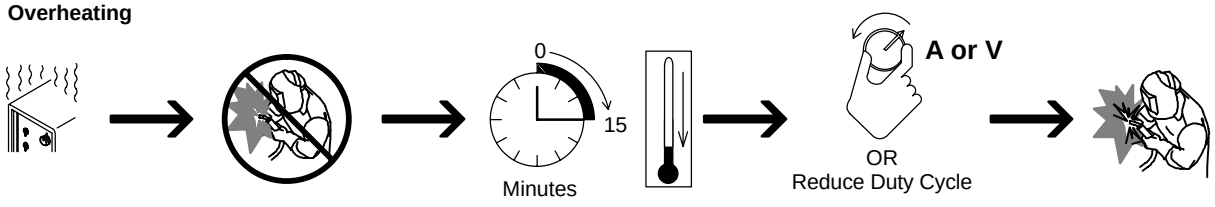
150 A @ 60% Duty Cycle For Stick Process (Other Voltages)

175 A @ 60% Duty Cycle For TIG Process (Other Voltages)



6 Minutes Welding 4 Minutes Resting

Overheating



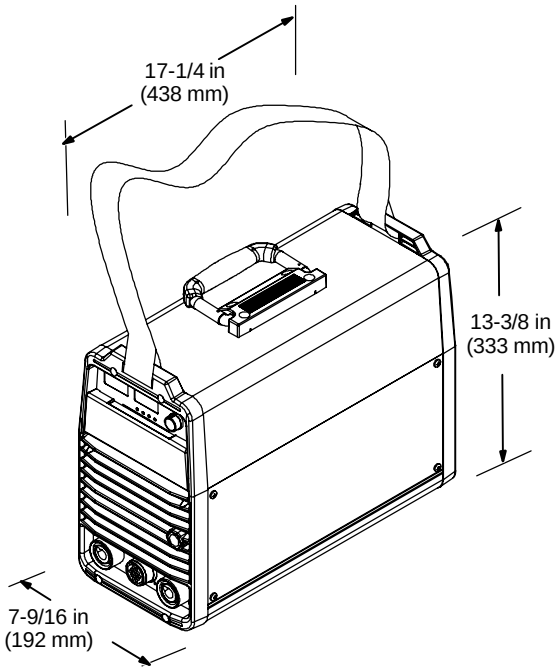
ST-189 770-A

3-4. Selecting A Location

Dimensions And Weight

34.7 lb (15.7 kg) - without power cord

37.3 lb (16.9 kg) - with power cord



1 Identification Plate

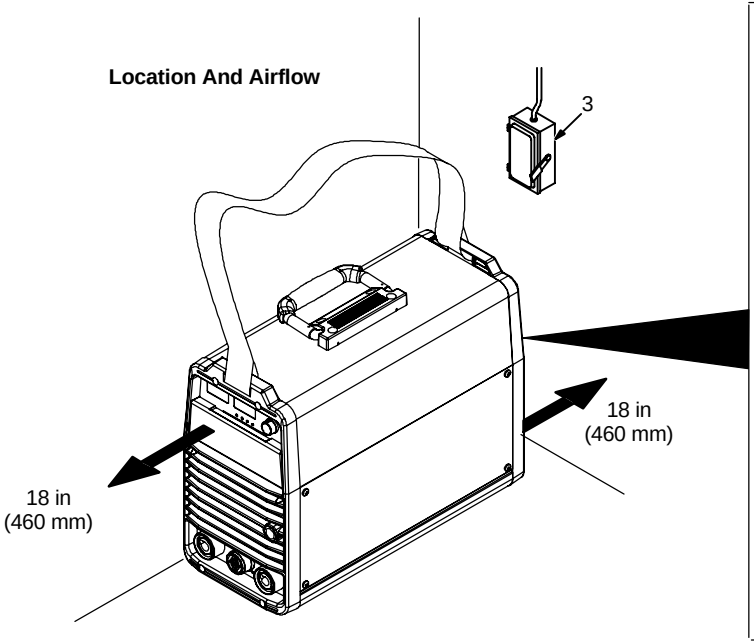
2 Rating Label

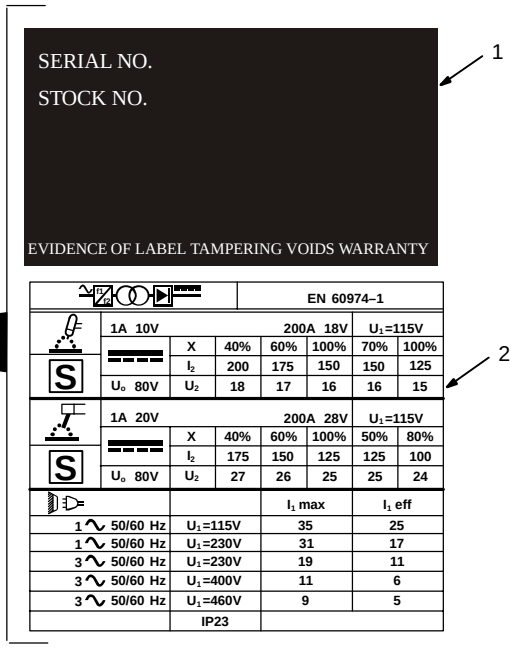
3 Line Disconnect Device

Locate unit near correct input power supply.

▲ **Special installation may be required where gasoline or volatile liquids are present – see NEC Article 511 or CEC Section 20.**

Location And Airflow





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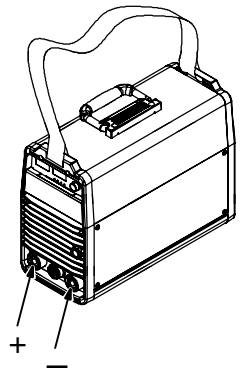
3-5. Weld Output Terminals And Selecting Cable Sizes*

▲ **Turn off power before connecting to weld output terminals.**

▲ **Do not use worn, damaged, undersized, or poorly spliced cables.**

Welding Amperes***	Weld Cable Size** and Total Cable (Copper) Length in Weld Circuit Not Exceeding							
	100 ft (30 m) Or Less		150 ft (45 m)	200 ft (60 m)	250 ft (70 m)	300 ft (90 m)	350 ft (105 m)	400 ft (120 m)
	10 – 60% Duty Cycle	60 – 100% Duty Cycle	10 – 100% Duty Cycle					
100	4 (20)	4 (20)	4 (20)	3 (30)	2 (35)	1 (50)	1/0 (60)	1/0 (60)
150	3 (30)	3 (30)	2 (35)	1 (50)	1/0 (60)	2/0 (70)	3/0 (95	3/0 (95)
200	3 (30)	2 (35)	1 (50)	1/0 (60)	2/0 (70)	3/0 (95)	4/0 (120)	4/0 (120)



Output Receptacles

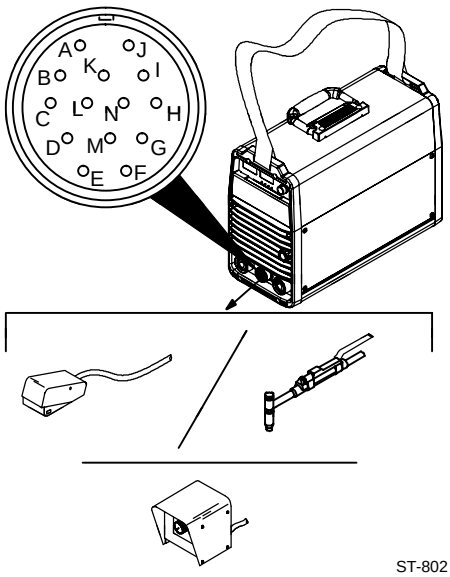
* This chart is a general guideline and may not suit all applications. If cable overheating occurs (normally you can smell it), use next size larger cable.

**Weld cable size (AWG) is based on either a 4 volts or less drop or a current density of at least 300 circular mils per ampere.
( ) = mm^2 for metric use

***Select weld cable size for pulsing application at peak amperage value.

S-0007-E–

3-6. Remote 14 Receptacle Information



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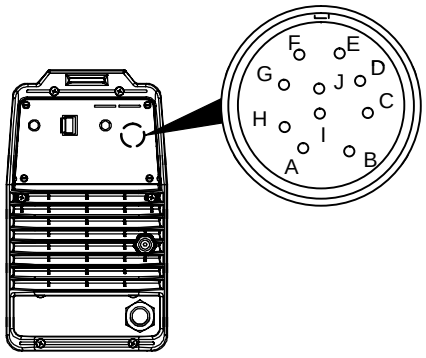
REMOTE 14	Socket*	Socket Information
15 VOLTS DC **OUTPUT CONTACTOR**	A	Contactor control +15 volts dc.
	B	Contact closure to A completes 15 volts dc contactor control circuit and enables output.
REMOTE OUTPUT CONTROL	C	Output to remote control; 0 to +10 volts dc output to remote control.
	D	Remote control circuit common.
	E	0 to +10 volts dc input command signal from remote control.
A/V AMPERAGE VOLTAGE	F	Current feedback; +1 volt dc per 100 amperes.
	H	Voltage feedback; +1 volt dc per 10 volts output.
GND	G	+15 volts dc GND
CHASSIS	K	Chassis common.

*The remaining sockets are not used.

Note: If a remote hand control, like the RHC-14, is connected to the Remote 14 receptacle, some current value above min. must be set on the remote control before the Panel or Remote contactor is turned on. Failure to do so, will cause current to be controlled by the panel control and the remote hand control will not function.

3-7. Automation 10-Pin Connection (LX Models)



Ref. ST-802 458

Socket	Socket Information For 10-Pin Receptacle RC2
A	Start/Stop
B	Gas
C	Output enable
D	Chassis ground
E	Final slope – collector
F	Final slope – emitter
G	Pulse lockout – collector
H	Pulse lockout – emitter
I	Valid arc – collector
J	Valid arc – emitter

Definitions Of Inputs And Outputs

Inputs

A - Closure to D starts the weld cycle. Opening closure stops weld cycle. During 2T operation, a momentary closure (greater than 100ms, but less than 3/4 seconds) starts and stops weld output.

B - Closure to D turns on gas. If a preflow time is entered, the preflow cycle will time out before arc initiation. If a post flow time is entered, the post flow cycle will time out at the end of the weld, even if B to D closure is opened.

C - Closure to D must be maintained at all times. If the closure between pins C and D is broken, an output disable occurs, Postflow begins to time out, and *HELP 13* will be displayed on the meters.

Outputs

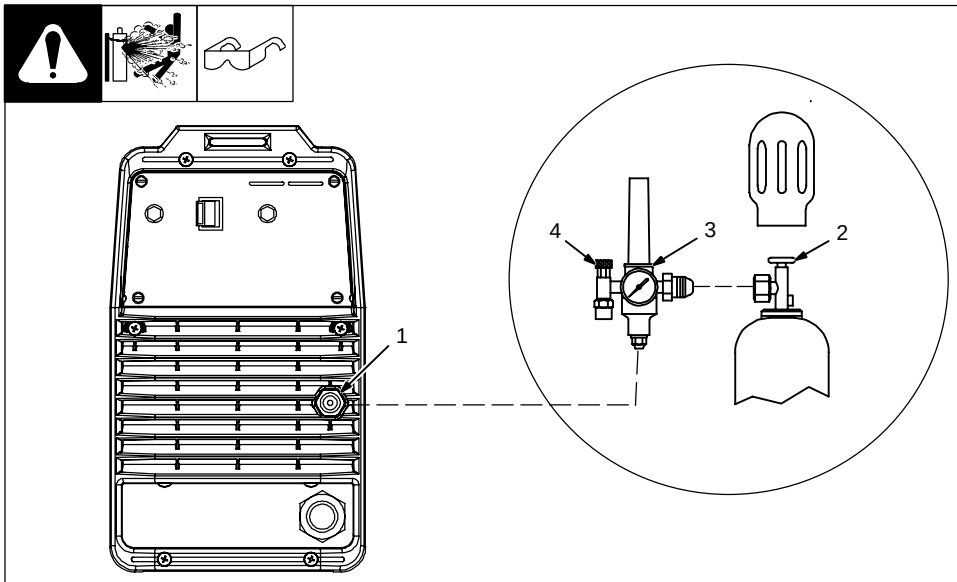
Outputs are isolated open-collector transistor which are able to conduct at least 6 mA of current, with a maximum of 100 mA of current and 30 VDC.

Final Slope - output is on when in Final Slope.

Pulse Lockout - output is on when in Initial Amperage, Initial Slope, Final Slope, Final Amperage, during background time, and when the pulse frequency is less than 10 Hz.

Arc On - output is on when the contactor is on and amperage is greater than 5 amps, or output voltage is greater than 5 volts but less than 50 volts.

3-8. Gas Connections



1 Gas Fitting

Fittings have 5/8-18 right-hand threads (3/8-19 BSPP on CE units).

2 Cylinder Valve

Open valve slightly so gas flow blows dirt from valve. Close valve.

3 Regulator/Flowmeter

4 Flow Adjust

Typical flow rate is 15 cubic feet per hour (7.1 liters per minute).

Connect customer supplied gas hose between regulator/flowmeter and gas fitting on rear of unit.

Tools Needed:

11/16, 1-1/8 in, (21 mm)

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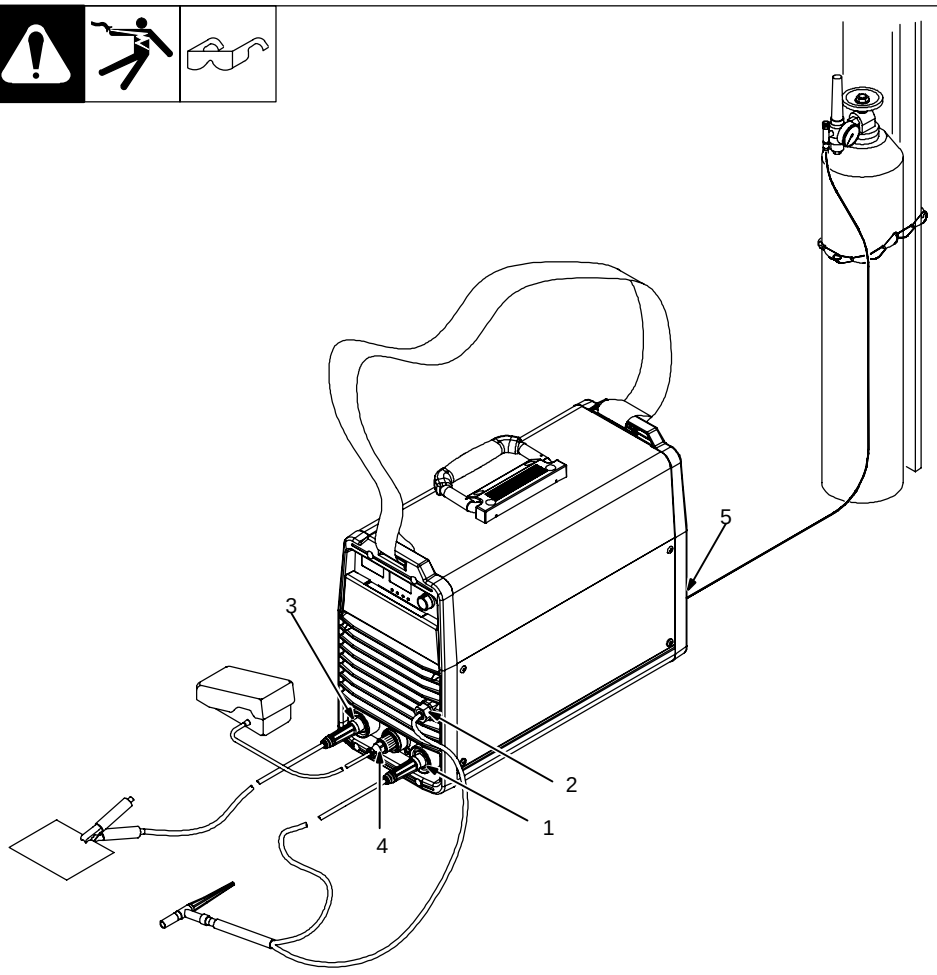
3-9. TIG HF Impulse/ Lift-Arc™ DCEN (Direct Current Electrode Negative) Connections



▲ **Turn off power before making connections.**

1 Negative (–) Weld Output Terminal

Connect TIG torch to negative weld output terminal.

2 Gas Out Connection

Connect torch gas hose to gas out fitting.

3 Positive (+) Weld Output Terminal

Connect work lead to positive weld output terminal.

4 Remote 14 Receptacle

Connect desired remote control to Remote 14 receptacle.

5 Gas In Connection

Connect gas hose from gas supply to gas in fitting.

Tools Needed:

11/16 in, (21 mm)

Ref. ST-802 471

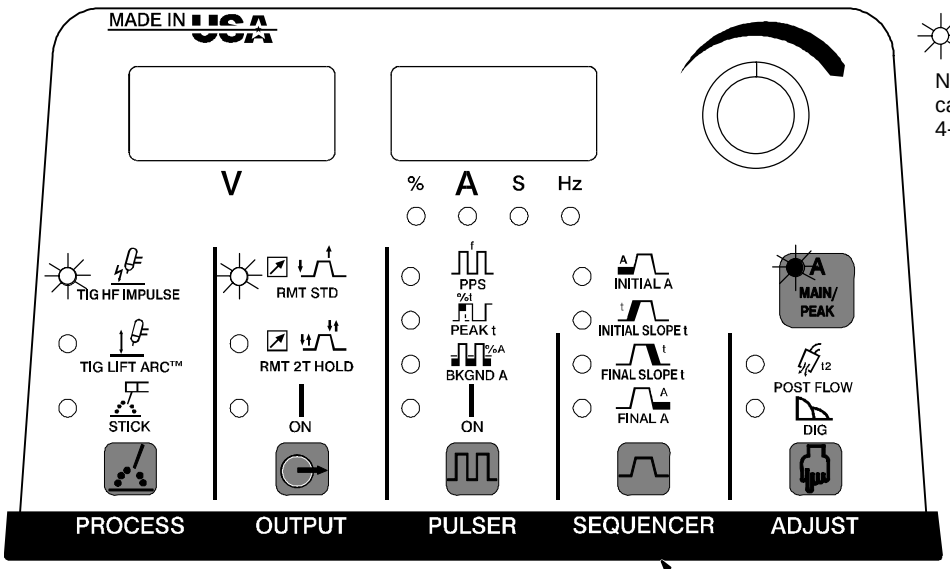
3-10. Front Panel Display For TIG HF Impulse DCEN (Direct Current Electrode Negative)

1 Front Panel

Correct front panel display for basic TIG HF Impulse DCEN welding.

☞ *For all front panel switch pad controls: press switch pad to turn on light and enable function.*

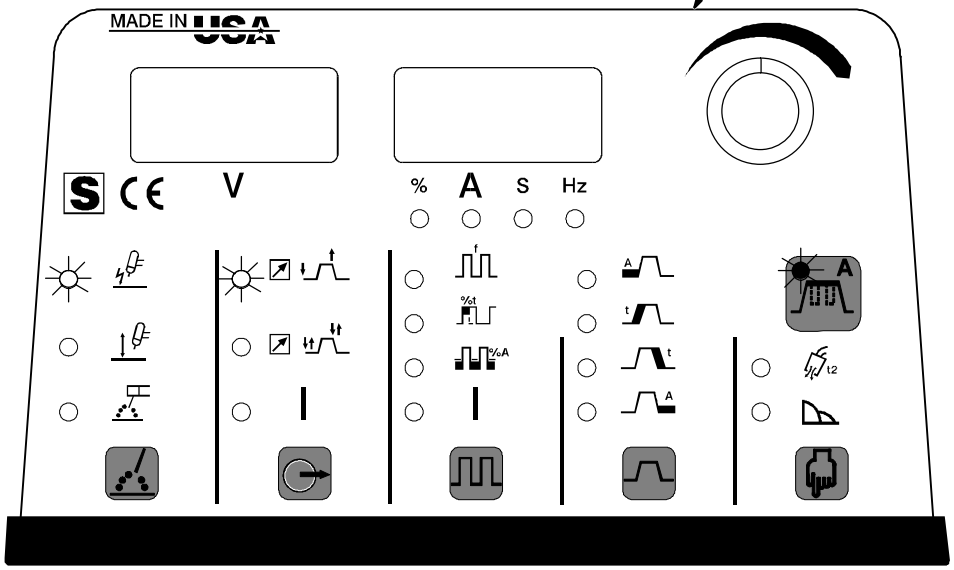
NOTE: Green on nameplate indicates a TIG function (see Section 4-1 for description of controls).



ST-192 885

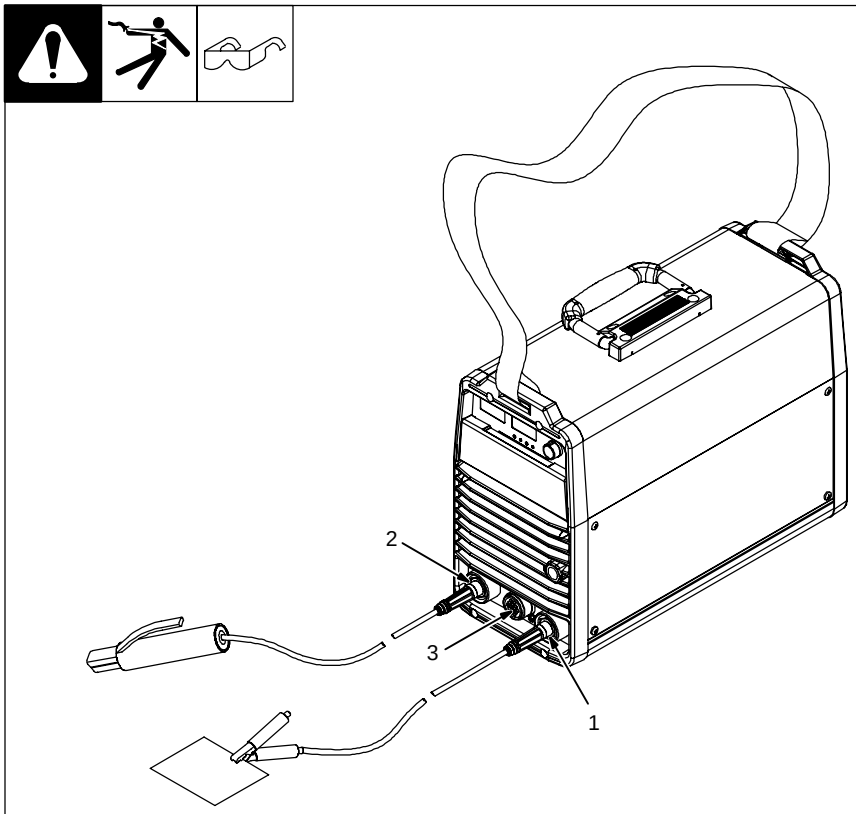
1

CE Models



ST-192 889

3-11. Stick DCEP (Direct Current Electrode Positive) Connections



▲ **Turn off power before making connections.**

1 Negative (–) Weld Output Terminal

Connect work lead to negative weld output terminal.

2 Positive (+) Weld Output Terminal

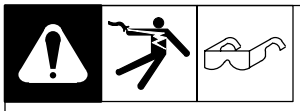
Connect electrode holder to positive weld output terminal.

3 Remote 14 Receptacle

If desired, connect remote control to Remote 14 receptacle (see Section 3-6).

Ref. ST-802 471

3-12. Front Panel Display For Stick DCEP (Direct Current Electrode Positive)

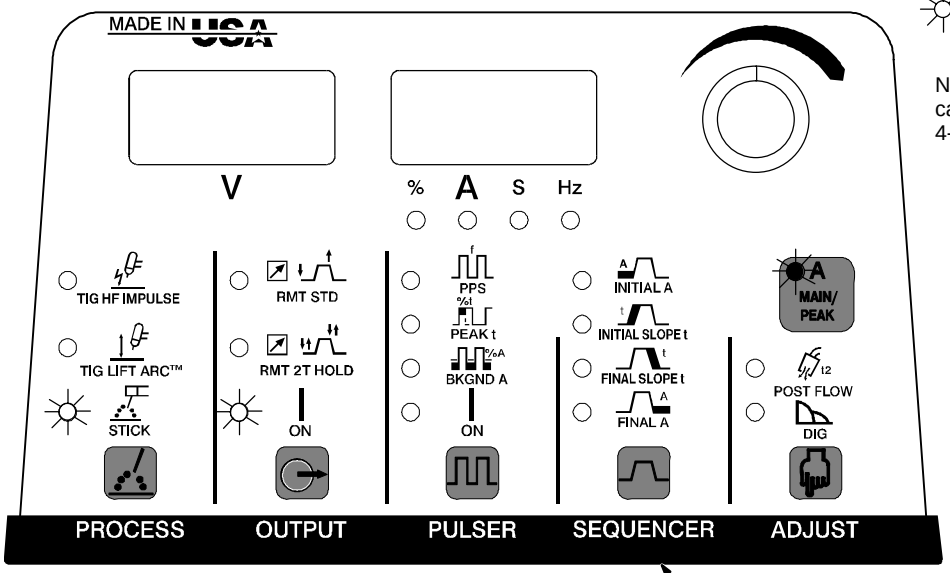


1 Front Panel

Correct front panel display for basic Stick DCEP welding.

For all front panel switch pad controls: press switch pad to turn on light and enable function.

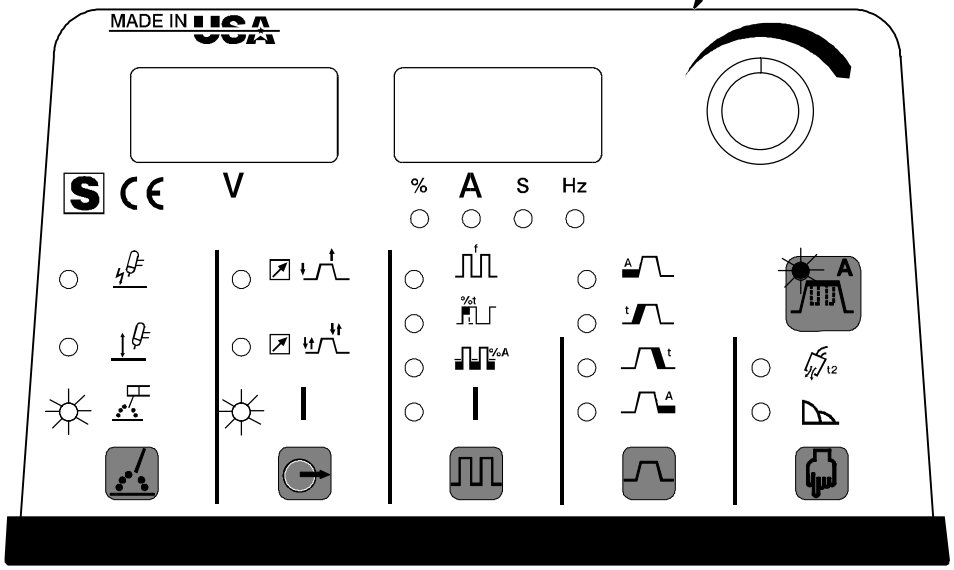
NOTE: Gray on nameplate indicates a Stick function (see Section 4-1 for description of controls).



ST-192 885

1

CE Models



ST-192 889

3-13. Electrical Service Guide

NOTE ☞ *Actual input voltage cannot exceed ± 10% of indicated required input voltage. If actual input voltage is outside of this range, no output is available.*

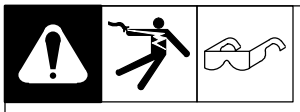
	Single-Phase, 100% Duty Cycle	Single-Phase, 60% Duty Cycle	Three-Phase, 60% Duty Cycle		
Input Voltage	115	230	230	400	460
Input Amperes At Rated Output	25	22	13.1	7.4	6.4
Max Recommended Standard Fuse Rating In Amperes[1] **Normal Operating [2]**	35	30	20	10	10
Min Input Conductor Size In AWG/Kcmil	10	12	14	14	14
Max Recommended Input Conductor Length In Feet (Meters)	57 (17)	79 (24)	102 (31)	308 (94)	407 (124)
Min Grounding Conductor Size In AWG/Kcmil	10	12	14	14	14

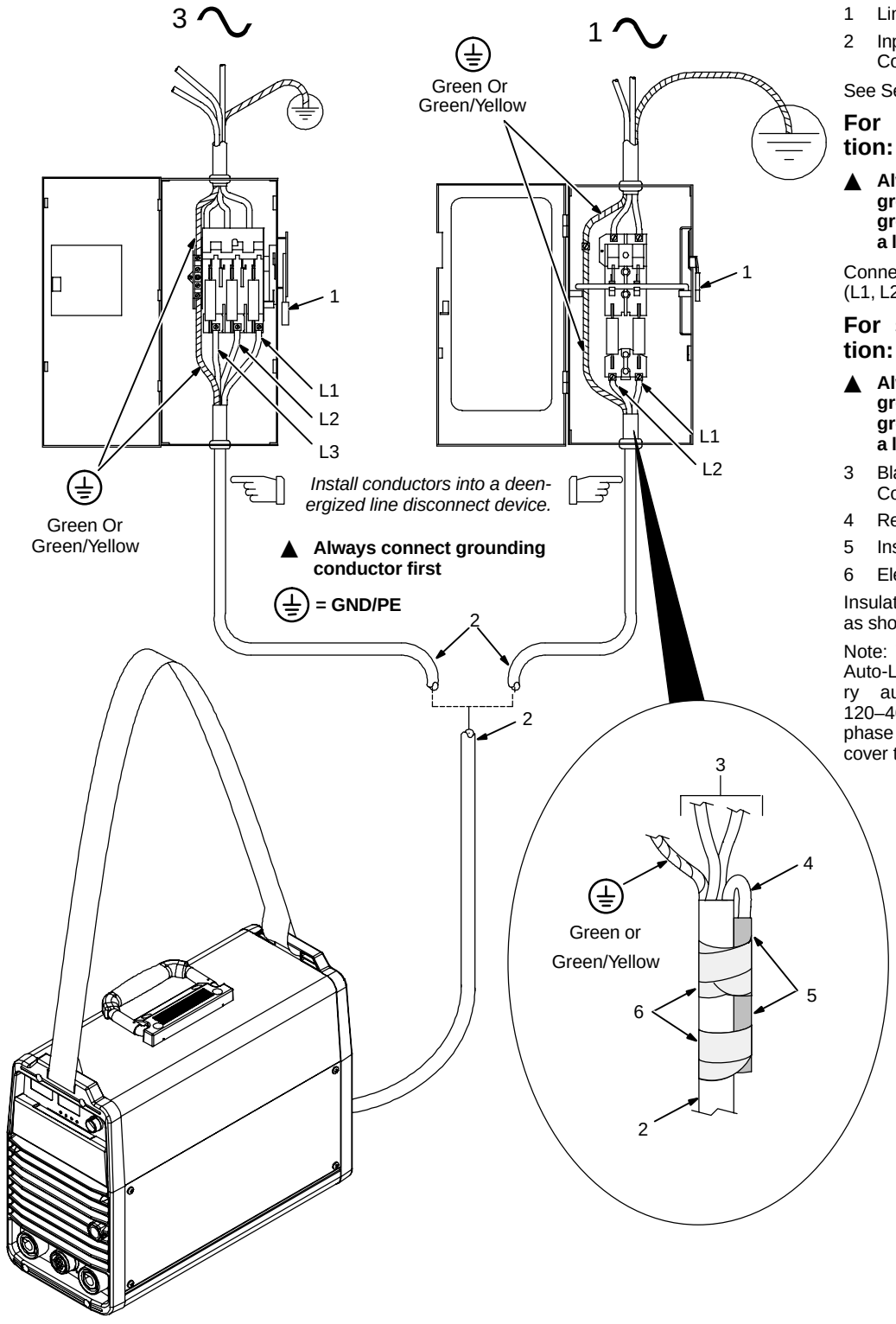
Reference: 1999 National Electrical Code (NEC)

1 Consult factory for circuit breaker applications.

2 “Normal Operating” (general purpose - no intentional delay) fuses are UL class “K5” (up to and including 60 amp), and UL class “H” (65 amp and above).

3-14. Connecting Input Power





▲ **Disconnect and lockout/tagout input power before connecting input conductors from unit.**

▲ **Have only qualified persons make this installation.**

Check input voltage available at site.

1 Line Disconnect Device

2 Input And Grounding Conductors

See Section 3-13.

For three-phase operation:

▲ **Always connect green or green/yellow wire to supply grounding terminal, never to a line terminal.**

Connect black, white, and red wires (L1, L2, L3) to line terminals.

For single-phase operation:

▲ **Always connect green or green/yellow wire to supply grounding terminal, never to a line terminal.**

3 Black And White Input Conductor

4 Red Input Conductor

5 Insulation Sleeving

6 Electrical Tape

Insulate and isolate red conductor as shown.

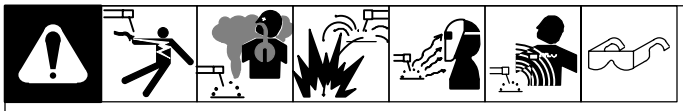
Note: This unit is equipped with Auto-Line™. The Auto-Line circuitry automatically connects to 120–460 VAC, single- or three-phase power without removing the cover to relink the power source.

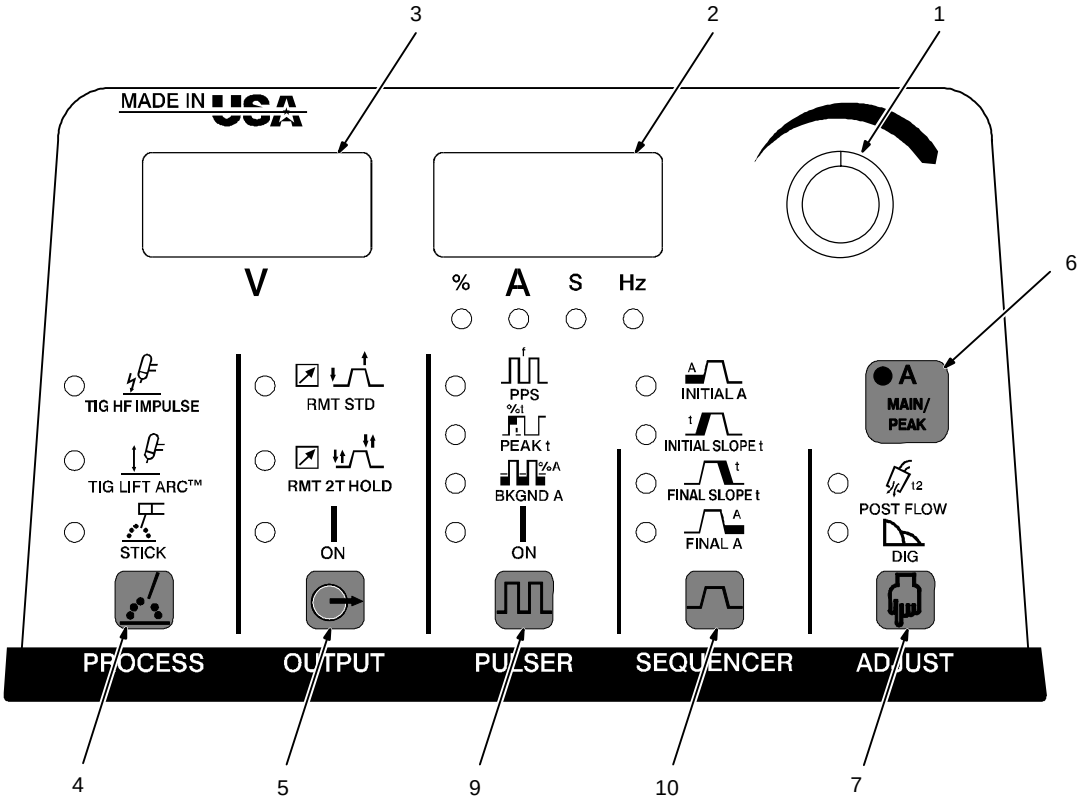
input_2 3/96 - ST-802 454

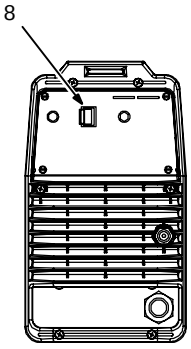
SECTION 4 – OPERATION

4-1. Controls

A. Non CE Units (DX/LX Model Shown)







☞ *For all front panel switch pad controls: press switch pad to turn on light and enable function.*

NOTE: Green on nameplate indicates a TIG function, Gray indicates a Stick function.

1 Encoder Control

Use encoder control in conjunction with applicable front panel function switch pads to change values for that function. See Section 4-2.

2 Parameter Display

See Section 4-3.

3 Voltmeter

See Section 4-3.

4 Process Controls

See Section 4-4.

5 Output Controls

See Section 4-7.

To reconfigure 2T control for use as 4T, 4TE, Mini Logic control, or Spot control see Section 4-14.

6 Amperage Control

See Section 4-8.

7 Adjust Controls

See Section 4-9.

8 Power Switch

Use switch to turn unit On/Off.

9 Pulser Controls (DX And LX Models)

See Section 4-10.

10 Sequencer Controls (DX, LX And All CE Models)

See Section 4-11.

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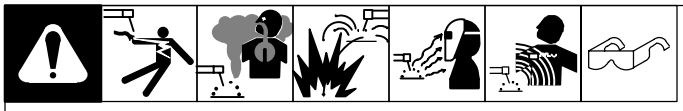
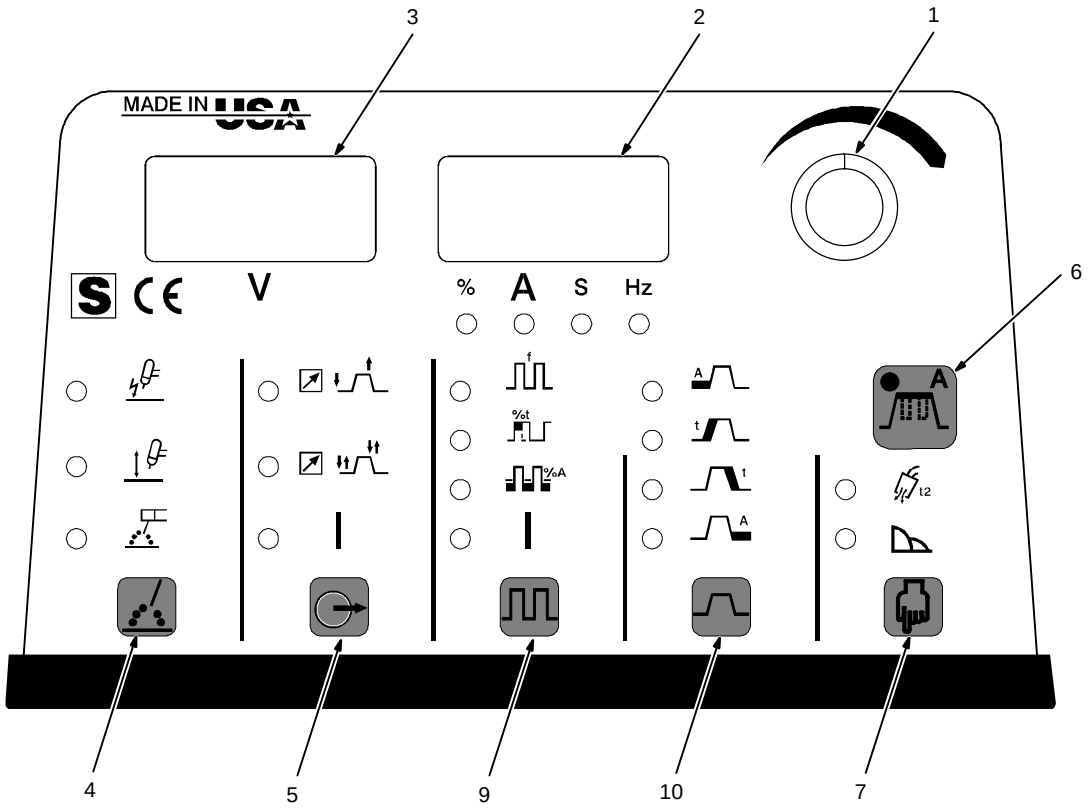
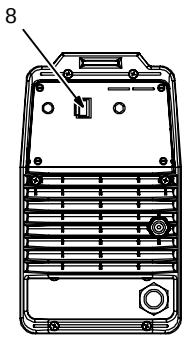
B. For CE Units (DX/LX Model Shown)







☞ *For all front panel switch pad controls: press switch pad to turn on light and enable function.*

NOTE: Green on nameplate indicates a TIG function, Gray indicates a Stick function.

1 Encoder Control

Use encoder control in conjunction with applicable front panel function switch pads to change values for that function. See Section 4-2.

2 Parameter Display

See Section 4-3.

3 Voltmeter

See Section 4-3.

4 Process Controls

See Section 4-4.

5 Output Controls

See Section 4-7.

To reconfigure 2T control for use as 4T, 4TE, Mini Logic control, or Spot control see Section 4-14.

6 Amperage Control

See Section 4-8.

7 Adjust Controls

See Section 4-9.

8 Power Switch

Use switch to turn unit On/Off.

9 Pulser Controls (DX And LX Models)

See Section 4-10.

10 Sequencer Controls (DX, LX And All CE Models)

See Section 4-11.

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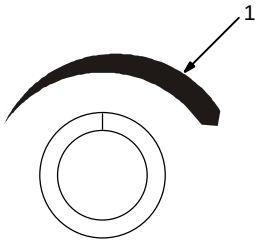
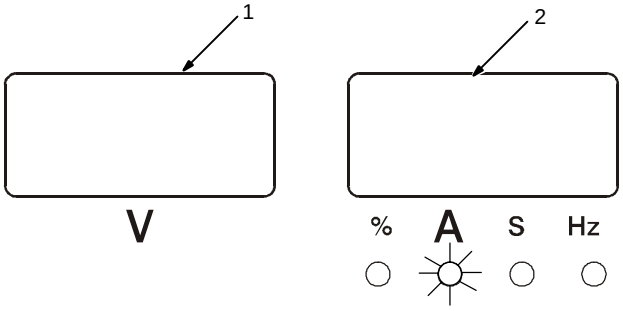
4-2. Encoder Control



1 Encoder Control

Use control in conjunction with applicable front panel function switch pad to set values for that function.

4-3. Ammeter And Volt Meter



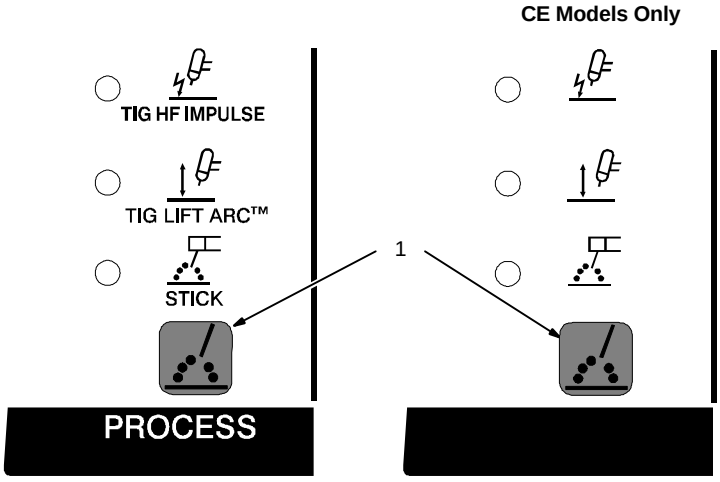
V 1 Volt Meter

Displays output or open circuit voltage. If output is off, the voltmeter will display a series of three dashes (-—). Open circuit voltage is displayed if power is on and output is available.

% A S Hz 2 Parameter Display

Displays actual amperage while welding. Meter also displays preset parameters for any of the following units of measure when they are active: amperage, time, percentage or frequency. The corresponding LED, located directly below the ammeter, will also illuminate.

4-4. Process Control



1 Process Control

Press switch pad until desired process LED is illuminated:

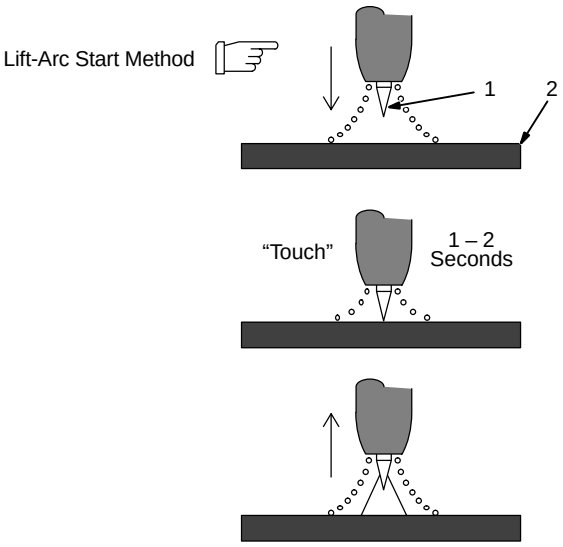
TIG HF Impulse - This is a DCEN (direct current electrode negative) process with a pulsed HF (non-contact) (see Section 4-5) arc starting method. Make connections according to Section 3-9.

TIG Lift-Arc™ - This is a DCEN (direct current electrode negative) process in which the electrode must come in contact with the work piece to initiate an arc (see Section 4-5). Make connections according to Section 3-9.

Stick (SMAW) - This is a DCEP (direct current electrode positive) process. Make connections according to Section 3-11.

Ref. ST-192 891

4-5. Lift-Arc™ And HF TIG Start Procedures



Lift-Arc Start

When Lift-Arc™ button light is On, start arc as follows:

1 TIG Electrode

2 Workpiece

Touch tungsten electrode to workpiece at weld start point, enable output with torch trigger, foot control, or hand control. **Hold electrode to workpiece for 1-2 seconds**, and slowly lift electrode. Shielding gas begins to flow when electrode touches workpiece and arc is formed when electrode is lifted.

Normal open-circuit voltage is not present before tungsten electrode touches workpiece; only a low sensing voltage is present between electrode and workpiece. The solid-state output contactor does not energize until after electrode is touching workpiece. This allows electrode to touch workpiece without overheating, sticking, or getting contaminated.

Application:

Lift-Arc is used for the DCEN GTAW process when HF Start method is not permitted, or to replace the scratch method.

HF Start

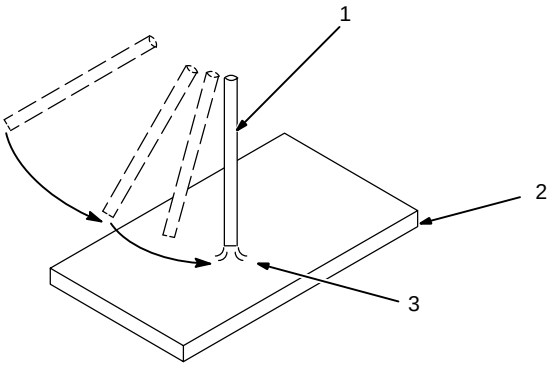
When HF Start button light is On, start arc as follows:

High frequency turns on to help start arc when output is enabled. High frequency turns off when arc is started, and turns on whenever arc is broken to help restart arc.

Application:

HF start is used for the DCEN GTAW process when a non-contact arc starting method is required.

4-6. Stick Start Procedure – Scratch Start Technique



With Stick selected, start arc as follows:

1 Electrode

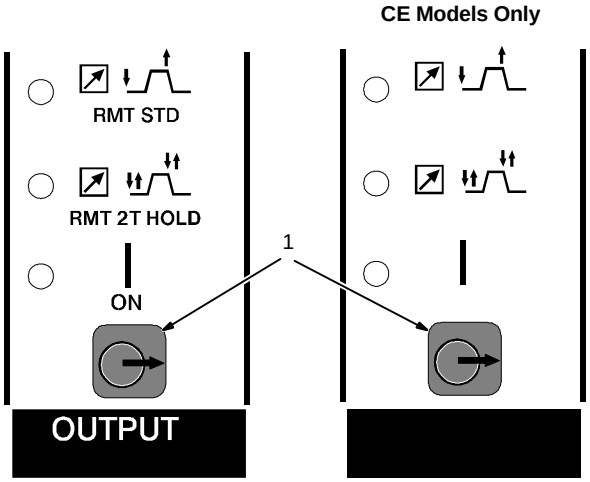
2 Workpiece

3 Arc

Drag electrode across workpiece like striking a match; lift electrode slightly after touching work. If arc goes out electrode was lifted to high. If electrode sticks to workpiece, use a quick twist to free it.

Normal open-circuit voltage is not present before electrode touches workpiece; only a low sensing voltage is present between electrode and workpiece.

4-7. Output Control



1 Output Control

Press switch pad until desired parameter LED is illuminated.

RMT STD (Remote Standard)

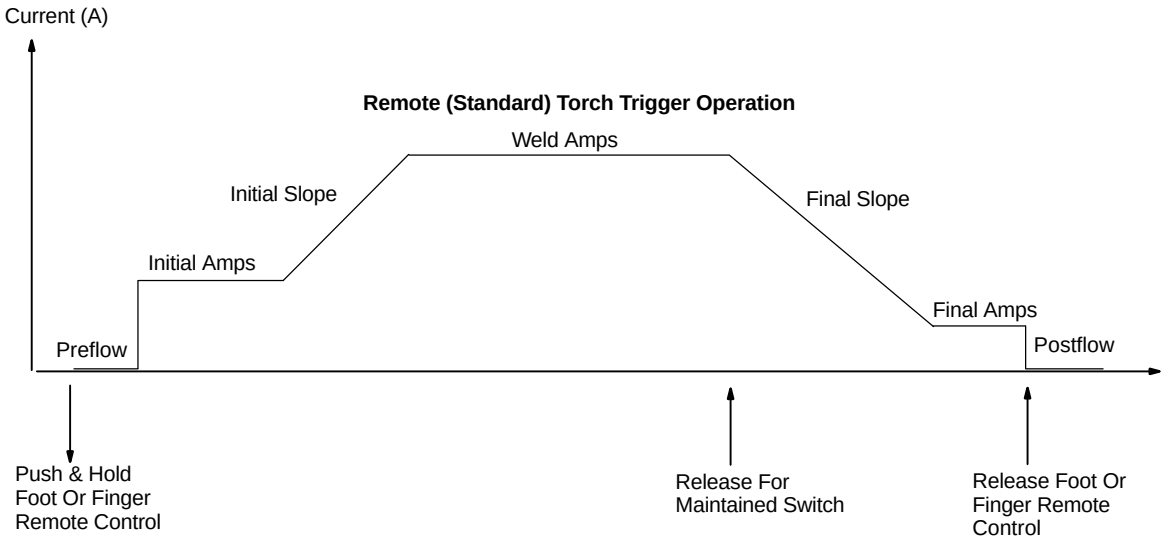
Torch trigger operation is as shown.

NOTE: When a foot or finger remote control is connected to the welding power source, initial amps, initial slope, final slope, and final amps are not functional.

NOTE: If a foot or finger control is connected, initial weld amperage, initial slope, final amperage, and final slope is controlled by the remote device, not by the welding power source.

NOTE: If On/Off only type trigger is used, it must be a maintained switch. All functions become active, and must be set by the operator.

Application: Use Remote Trigger when the operator desires to use a foot pedal or finger amperage control.



NOTE: If arc is broken and trigger is depressed, HLP-10 will be displayed (see Section 5-3).

1 Output Control

Press switch pad until desired parameter LED is illuminated.

RMT 2T Hold

Press switch pad to activate function.

Torch trigger operation is as shown.

NOTE: A foot or finger remote control must be connected to the welding power source, only trigger input is functional.

NOTE: Amperage is controlled by the welding power source.

NOTE: Switch function can be reconfigured for 4T, 4TE, Mini Logic, or Spot control (see Section 4-14).

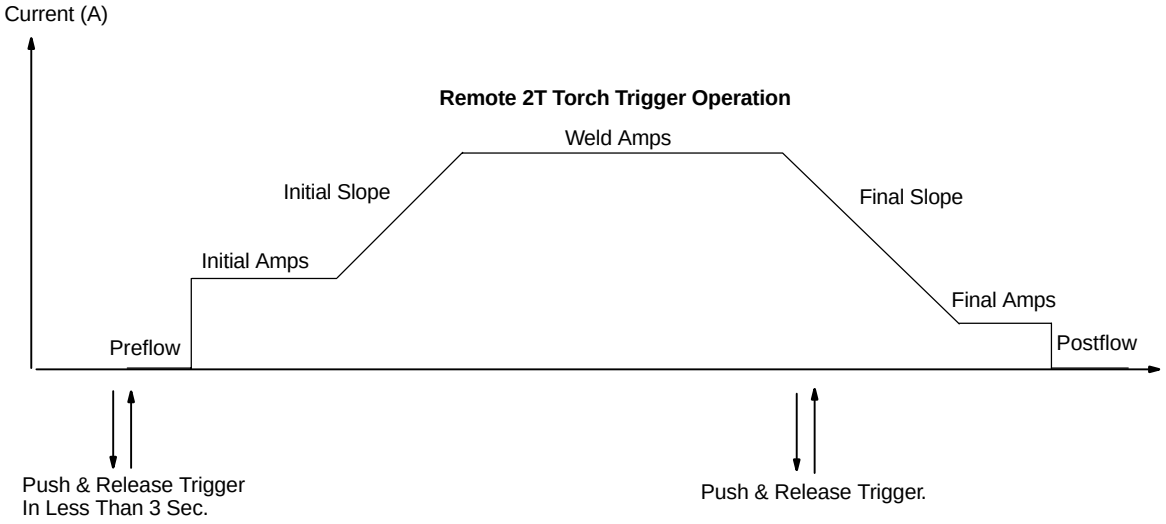
Application: Use Remote Trigger Hold (2T) when long extended welds are made. Remote Trigger Hold (2T) can help to reduce operator fatigue.

ON

Press switch pad to activate function. Output will be available when LED is illuminated.

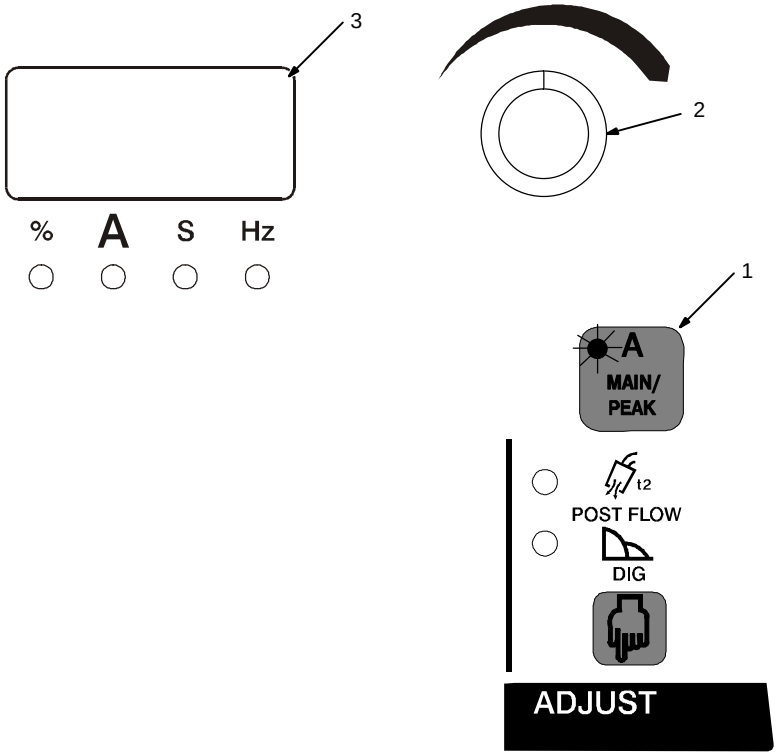
NOTE: A remote contactor control is not required.

Application: Use Output On for Stick (SMAW) welding, or for Lift-Arc without the use of a remote control.



NOTE: If torch trigger is held more than 3 seconds, operation reverts to Remote Trigger (Standard) mode. If arc is broken and trigger is depressed, HLP-10 will be displayed (see Section 5-3).

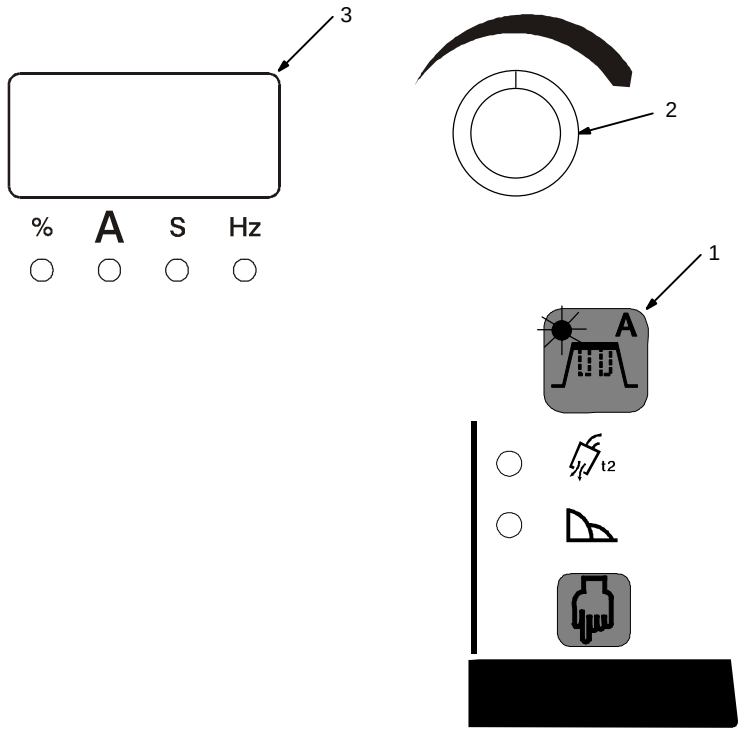
4-8. Amperage Control



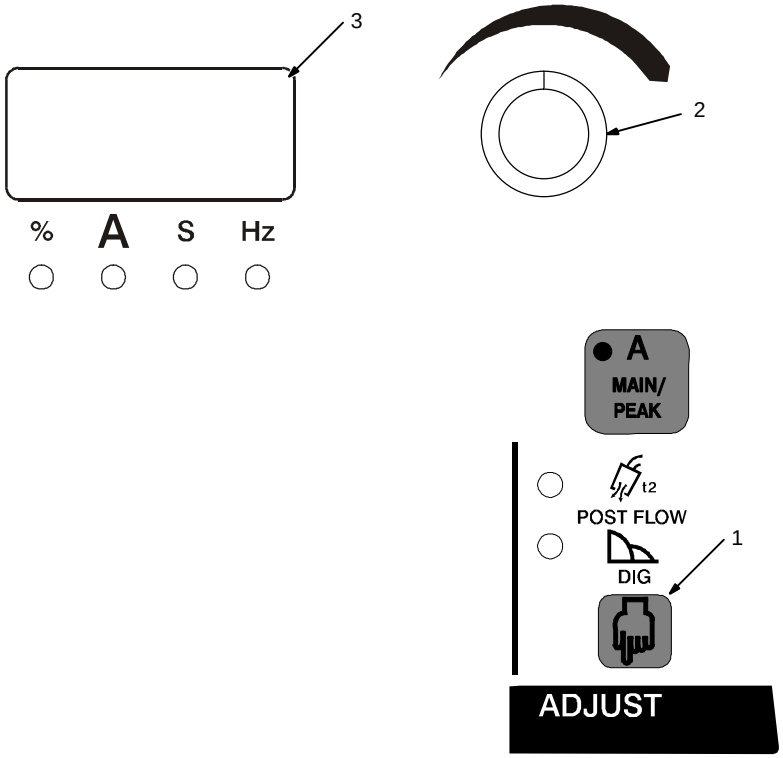
1 A (Amperage Control)
2 Encoder Control
3 Parameter Display

Press Amperage switch pad, and turn Encoder control to set weld amperage (1-200 amps). Weld amperage setting is also peak amperage when Pulser function is active (see Section 4-10). Amperage selected is displayed on the parameter display (see Section 4-3) and the A LED will be illuminated.

CE Models Only



4-9. Adjust Controls (Post Flow/DIG)



1 Post Flow/DIG Control

Press switch pad until desired function LED is illuminated.

2 Encoder Control

3 Parameter Display

Post Flow - If the TIG process is active (see Section 4-4), press switch pad and turn encoder control to set length of time (0–50 seconds) gas flows after welding stops. Time selected is displayed (see Section 4-3) and the S LED will be illuminated.

Application:

Postflow is required to cool tungsten and weld, and to prevent contamination of tungsten and weld. Increase postflow time if tungsten or weld are dark in appearance.

DIG - If the Stick process is active (see Section 4-4), press switch pad and turn encoder control to set amount of DIG (0-100%). When set at 0, short-circuit amperage at low arc voltage is the same as normal welding amperage.

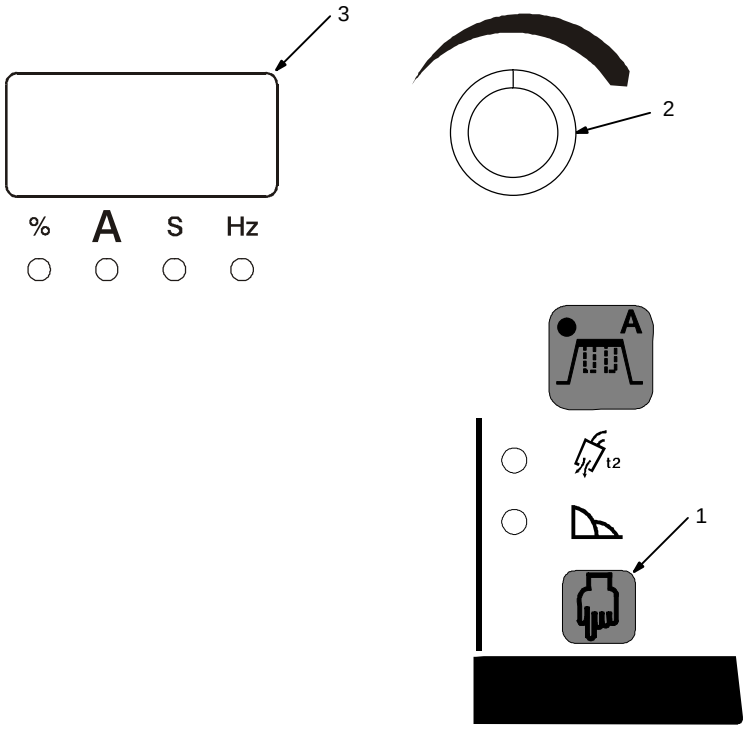
When setting is increased, short-circuit amperage at low arc voltage increases.

Percentage selected is displayed (see Section 4-3) and the % LED will be illuminated.

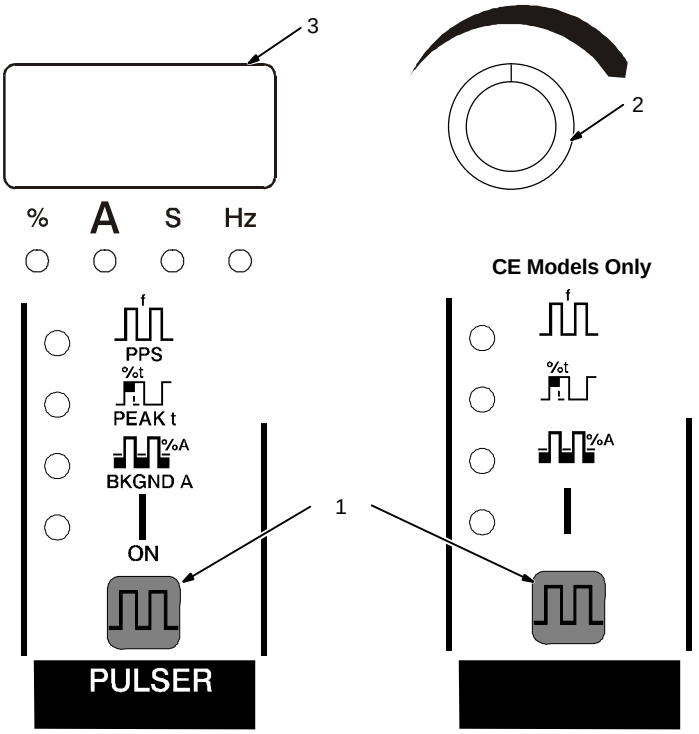
Application:

Control helps arc starting or making vertical or overhead welds by increasing amperage at low arc voltage, and reduces electrode sticking while welding.

CE Models Only



4-10. Pulser Control (DX And LX Models)



4

Percent (%) Peak Time Control Setting		Pulsed Output Waveforms
Balanced	(50%)	PPS, Bkg Amp, Peak Amp
More Time At Peak Amperage	(80%)	
More Time At Background Amperage	(20%)	

1 Pulser Control

If the Pulser is off, pressing the switch pad will enable the pulser, and place it in the PPS (Pulses Per Second) mode and illuminate the On and PPS LEDs. Pressing the switch again, will first place it in the Peak Time mode, and then in the Background Amperage Mode and illuminate the corresponding LED. If you cycle past Background Amps, the Pulser will shut off and default to the Main/Peak Amperage control. If the Pulser control is on, and you leave to make changes to other functions, like Peak/Main Amperage, when you return and press the Pulser switch pad, you will start at the PPS function.

2 Encoder Control

3 Parameter Display

Turn encoder (see Section 4-2) to select appropriate value for active pulse parameter. Value selected is displayed, and the LED for the corresponding unit of measure, % or Hz, will be illuminated.

Pulser parameters are as follows:

On - When illuminated, this LED indicates the pulser is on.

PPS (Pulse Frequency) - Ranges from .1–500 pps (pulses per second). Control is used to determine appearance of weld bead.

Peak Time - A range of 5–95% of each pulse cycle can be spent at the peak amperage level.

BKGND A (Background Amps) - Use Background Amps control to set the low pulse of the weld amperage, which cools the weld puddle and affects overall heat input. Background Amps is set as a percentage (5-95%) of peak amperage.

4 Pulsed Output Waveforms

Example shows affect changing the Peak Time control has on the pulsed output waveform.

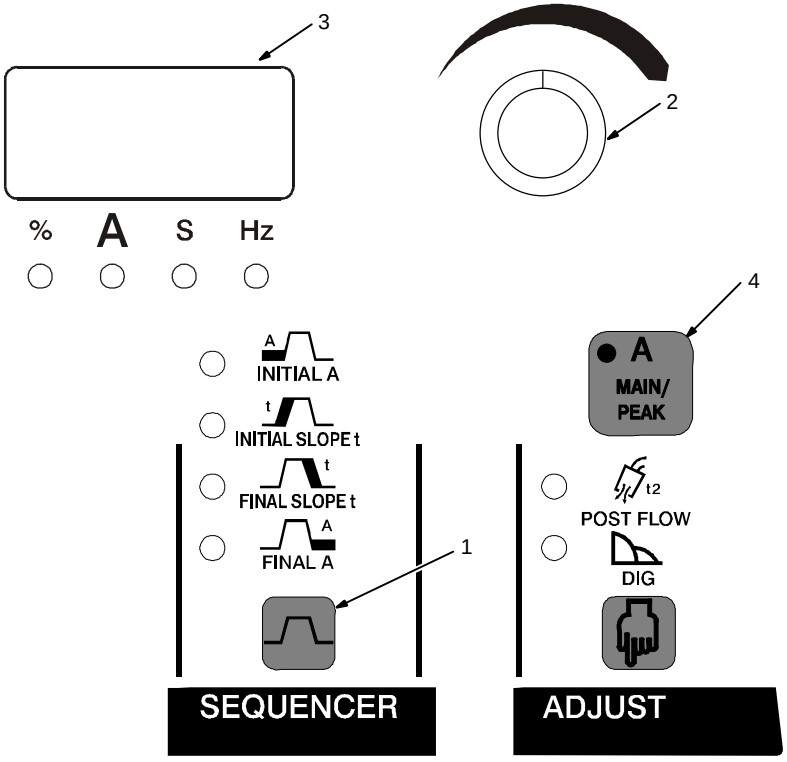
NOTE: Peak amperage is set using the Amperage control (see Section 4-8). Peak amperage (1–200 amps) is the highest welding amperage allowed to occur in the pulse cycle. Weld penetration varies directly with peak amperage.

Application:

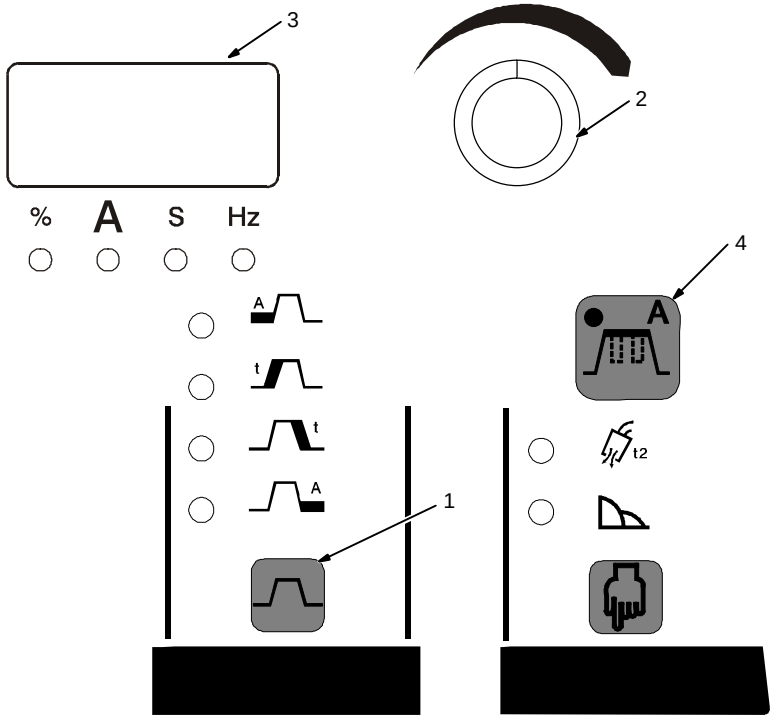
Pulsing refers to the alternating raising and lowering of the weld output at a specific rate. The raised portions of the weld output are controlled in width, height, and frequency, forming pulses of weld output. These pulses and the lower amperage level between them (called the background amperage) alternately heat and cool the molten weld puddle. The combined effect gives the operator better control of penetration, bead width, crowning, undercutting, and heat input. Controls can be adjusted while welding.

Pulsing can also be used for filler material addition technique training.

4-11. Sequencer Controls (DX, LX And All CE Models)



CE Models Only



1 Sequencer Control

Press switch pad until desired parameter LED is illuminated. Sequencing is available only while using the TIG process, but is disabled if a remote foot or finger control is connected to the Remote receptacle (see Section 3-6). Sequencer parameters cannot be selected if the Stick process (see Section 4-4) is active.

2 Encoder Control

3 Parameter Display

Turn encoder (see Section 4-2) to set appropriate value for active sequence parameter. Value selected is displayed on the parameter display, and the LED for the corresponding unit of measure (A, S) of the active parameter will be illuminated.

The Sequencer parameters are as follows:

Initial A (Initial Amperage) - Use control to select a starting amperage (1–200 amps) that is different from the weld amperage.

Application:

Initial Amperage can be used while GTAW welding to assist in preheating cold material prior to depositing filler material, or to ensure a soft start.

Initial t (Initial Time)**(LX Models Only) -** Use control to select 0-25 seconds of time that is needed at the beginning of the weld.

Initial Slope t (Initial Slope Time) Use control to select 0-25 seconds of time that it takes to slope up/down from initial amperage to weld amperage. To disable, set to 0.

4 Amperage Control

Use Amperage control (see Section 4-8) to adjust Weld Time for LX Models only.

Weld Time (LX Models Only) - Use control to select 0-999 seconds of time that is needed for weld sequence.

Final Slope t (Final Slope Time) - Use control to select 0-25 seconds of time that it takes to slope up/down from weld amperage to final amperage. To disable, set to 0.

Application:

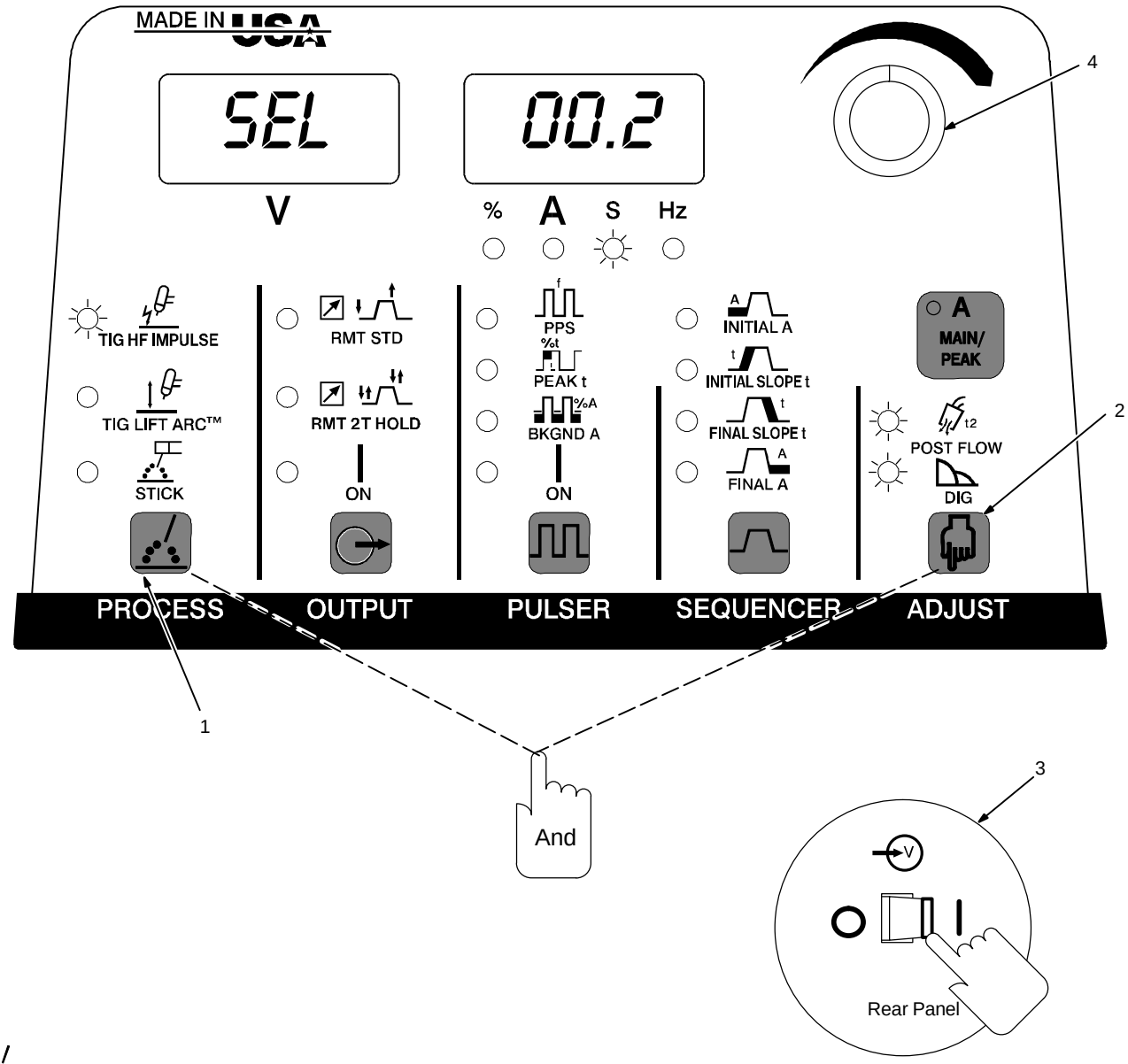
Final Slope should be used while GTAW welding materials that are crack sensitive, and/or the operator wants to eliminate the crater at the end of the weld.

Final A (Final Amperage) - Final amperage (1-200 amps) is the amperage to which weld amperage has sloped up/down to.

Final t (Final Time)**(LX Models Only)** - Use control to select 0-25 seconds of time that is needed at the end of the weld.

4-12. Preflow Adjust (All Models)

Non CE Models Only



1 Process Control Pad

2 Adjust Control Pad

3 Power Switch

To adjust preflow, turn power off, push and hold Process and Adjust control switch pads, and turn On Power switch. Hold switch pads for approximately 7 seconds (or until software version number _ _ _ _ _ _-_clears meters).

Upon power up as described, the TIG HF Impulse, Postflow, DIG, and meter S LED will turn on, and *(SEL) (0.2)* will be displayed. 0.2 seconds is the factory default setting for preflow.

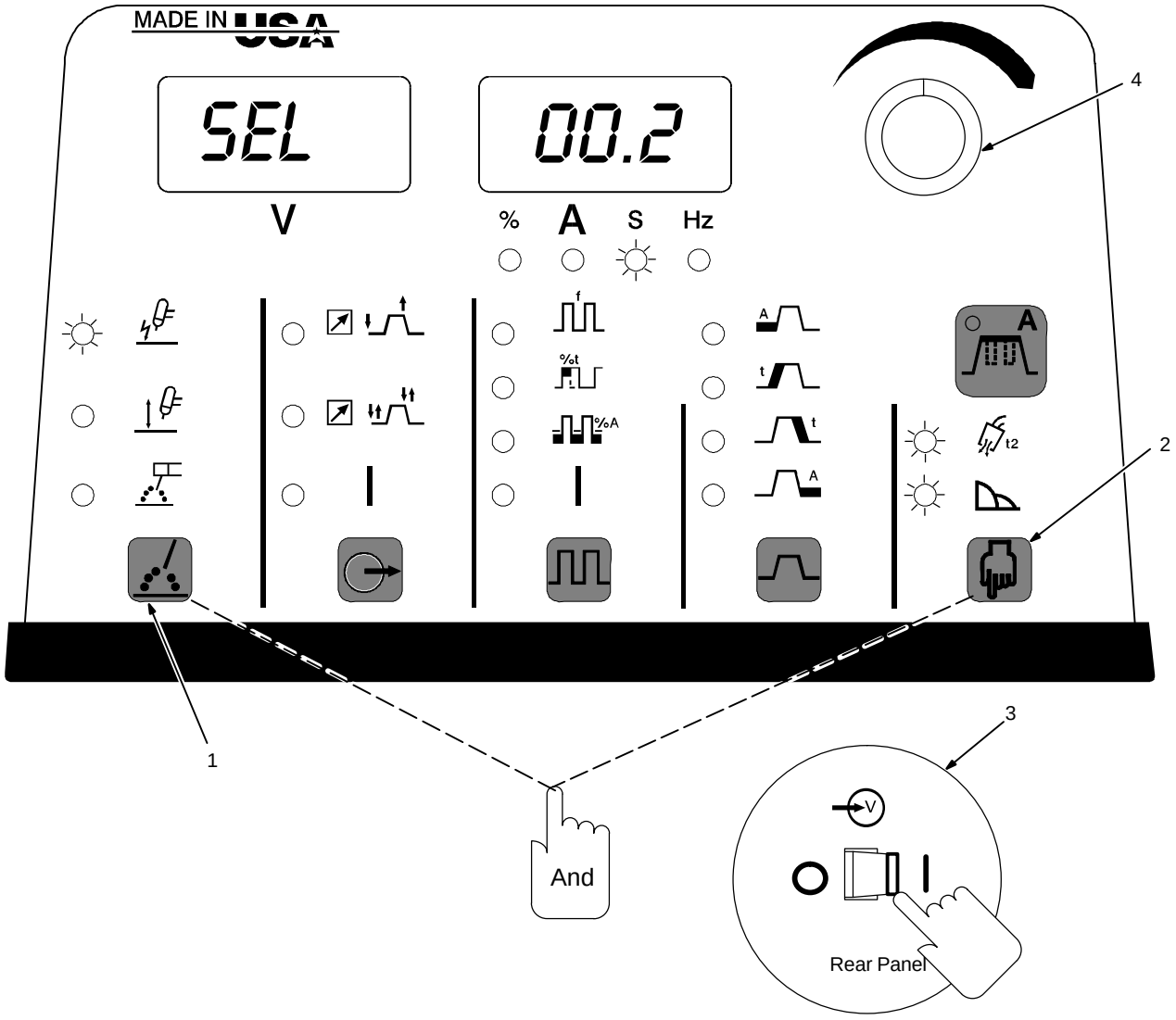
4 Encoder Control

Turn encoder to select from 0 to 25 seconds of preflow. Value selected will be displayed on ammeter.

Torch trigger activation or power down will save preflow setting and exit preflow setup.

Application: Preflow is used to purge the immediate weld area of atmosphere. Preflow also aids in consistent arc starting.

CE Models Only



1 Process Control Pad

2 Adjust Control Pad

3 Power Switch

To adjust preflow, turn Off power. Push and hold Process and Adjust control switch pads, and turn On Power switch. Hold switch pads for approximately 7 seconds (or until software version number _ _ _ _ _ _-_clears meters).

Upon power up as described, the TIG Impulse, Postflow, DIG, and meter S LED will turn on, and *(SEL) (0.2)* will be displayed. 0.2 seconds is the factory default setting for preflow.

4 Encoder Control

Turn encoder to select from 0 to 25 seconds of preflow. Value selected will be displayed on ammeter.

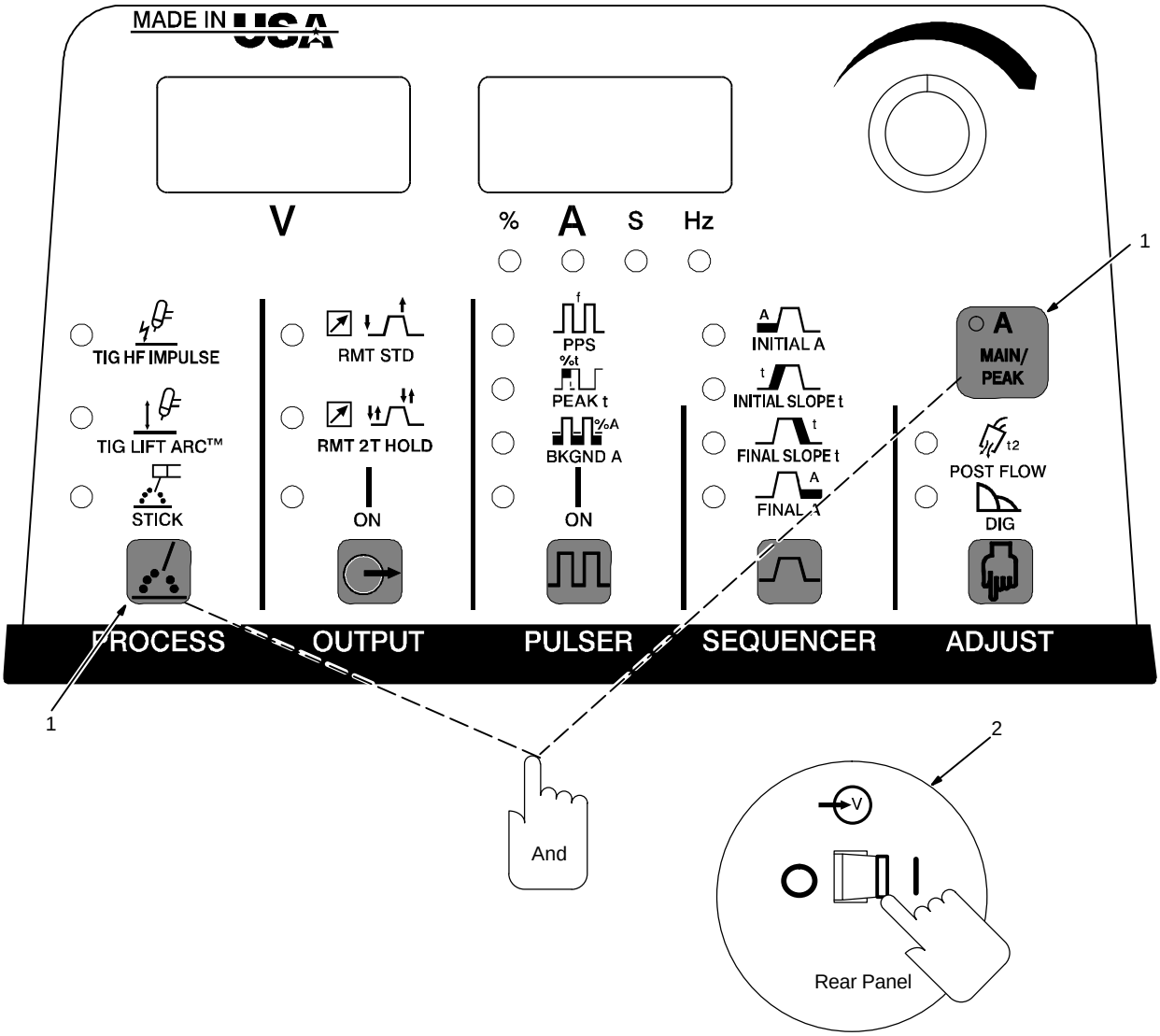
Torch trigger activation or power down will save preflow setting and exit preflow setup.

Application: Preflow is used to purge the immediate weld area of atmosphere. Preflow also aids in consistent arc starting.

4-13. Programmable TIG HF Impulse Start Amperage And Time Modes

A. Accessing Programmable TIG Start Amperage And Time Modes (All Models)

Non CE Models Only



NOTE: Before accessing programmable TIG HF Impulse Start Amperage and Time modes, be sure that all procedures and parameters are established. Especially, check for proper amperage setting (see Section 4-8). Parameter adjustment is limited while programmable TIG HF Impulse Start Amperage and Time modes are active.

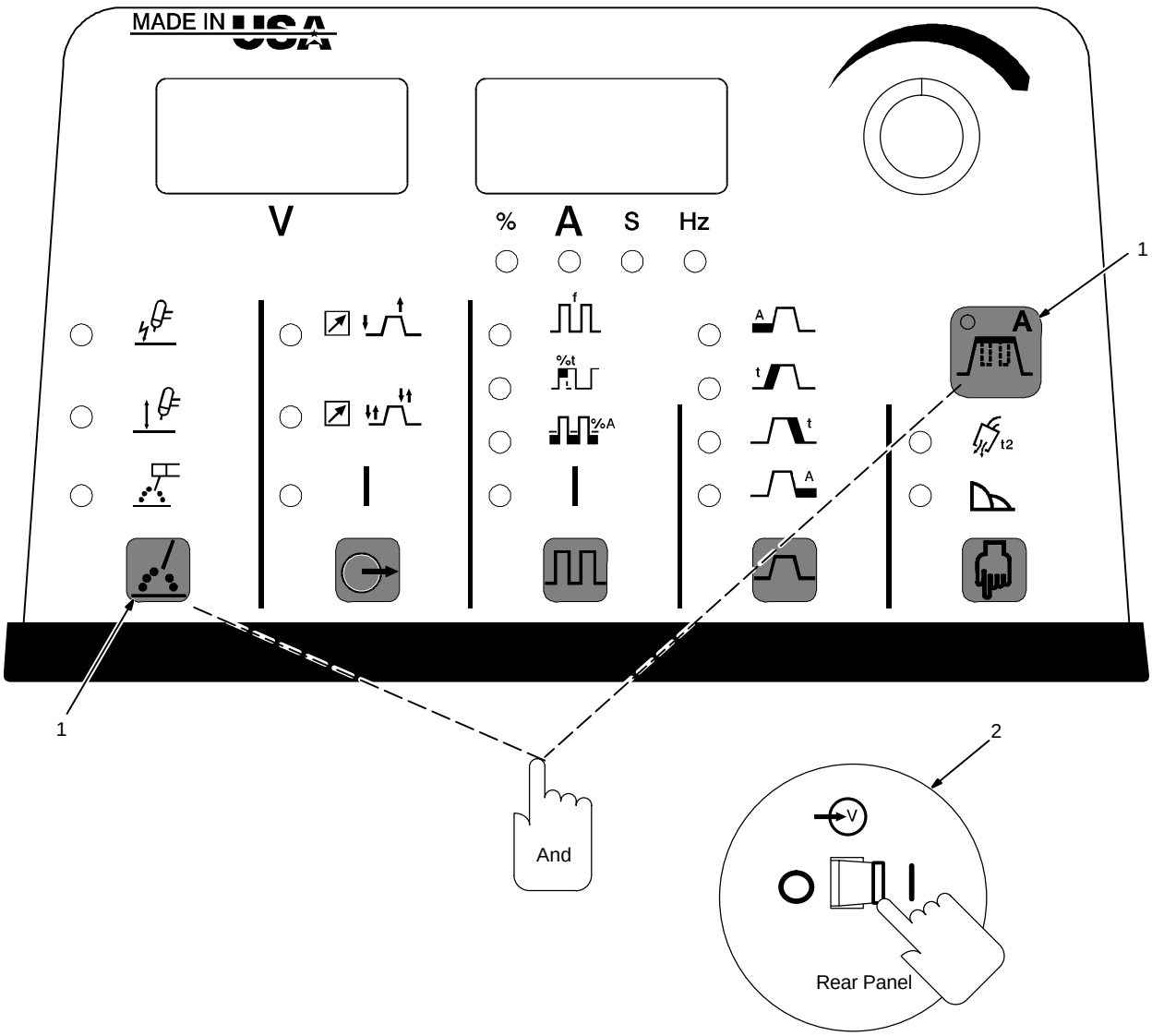
1 Process And Amperage Key Pads

2 Power Switch

To display the programmable TIG HF Impulse Start Amperage and Time screens, turn power Off. Push and hold Process and Amperage switch pads and turn On power switch. Hold switch pads for approximately 7 seconds (or until software version number _ _ _ _ _ _-_clears meters).

Proceed to Section B and/or C.

CE Models Only



NOTE: Before accessing programmable TIG HF Impulse Start Amperage and Time modes, be sure that all procedures and parameters are established. Especially, check for proper amperage setting (see Section 4-8). Parameter adjustment is limited while programmable TIG HF Impulse Start Amperage and Time modes are active.

1 Process And Amperage Key Pads

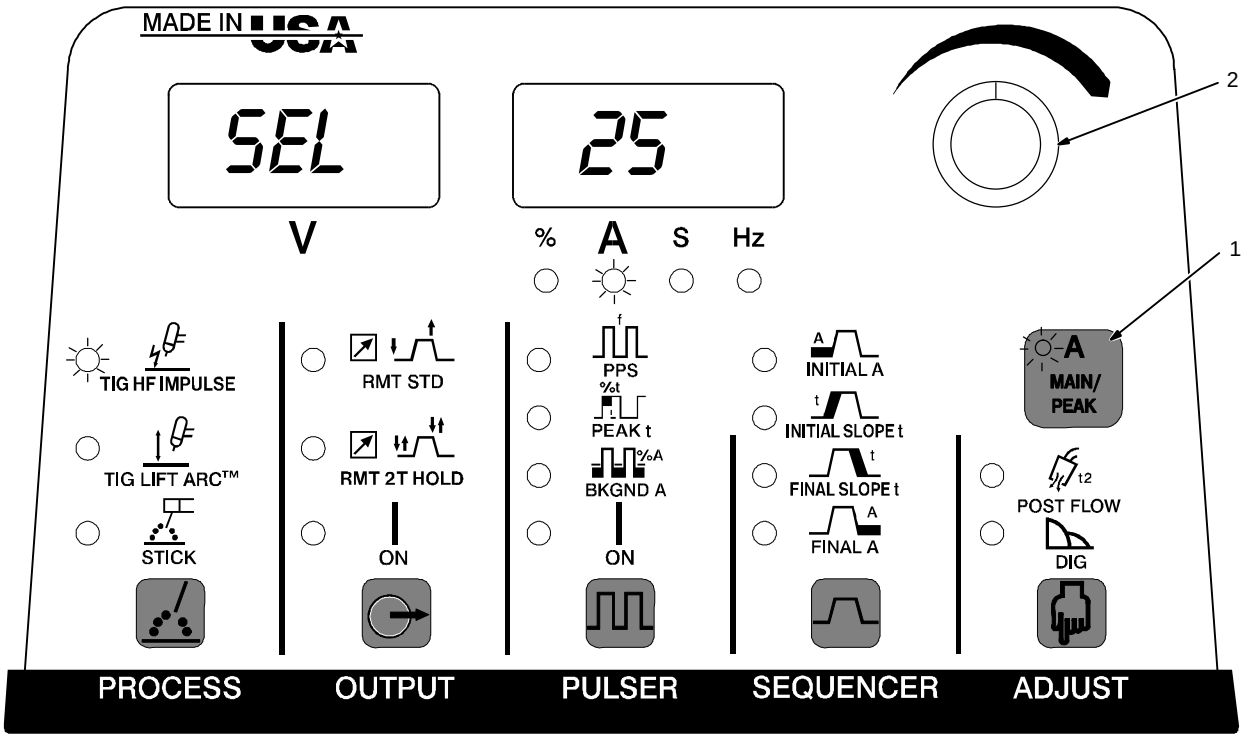
2 Power Switch

To display the programmable TIG HF Impulse Start Amperage and Time screens, turn Off power. Push and hold Process and Amperage switch pads and turn On power switch. Hold switch pads for approximately 7 seconds (or until software version number _ _ _ _ _ _-_clears meters).

Proceed to Section B and/or C.

B. Setting Programmable TIG Impulse Start Amperage (All Models)

Non CE Models Only



NOTE: Before accessing programmable TIG HF Impulse Start Amperage mode, be sure that all procedures and parameters are established. Especially, check for proper amperage setting (see Section 4-8). Parameter adjustment is limited while programmable TIG Impulse Start Amperage mode is active.

Welding cycle can be executed while in programmable start mode, but program parameters cannot be adjusted while in this mode.

A

1 Amperage Switch Pad

2 Encoder Control

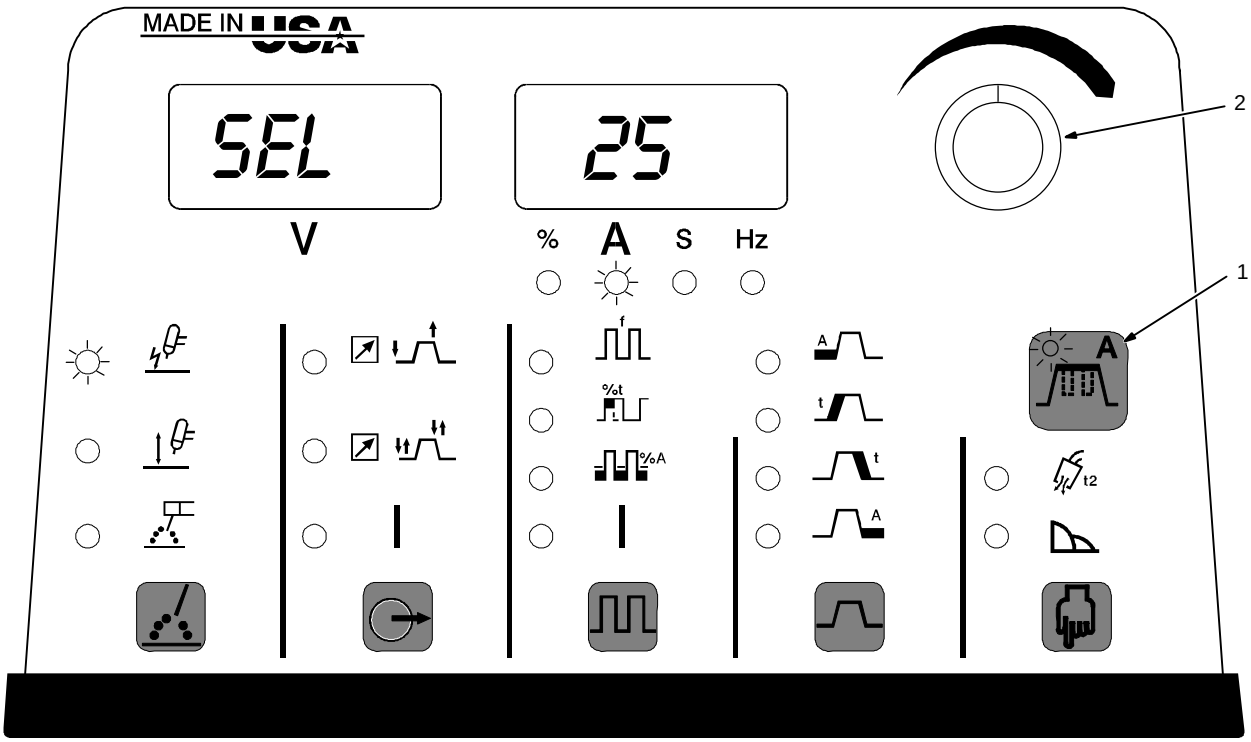
To adjust TIG HF Impulse Start Amperage proceed as follows:

Press Amperage switch pad. Switch pad LED turns on, meter A LED turns on, and *(SEL) (25)* is displayed on meters. TIG HF Impulse LED is on. Note: If a remote mode and pulser functions are active, their respective LEDs will be illuminated.

The "*25*" displayed on the amps meter is DC start amps (it is also the factory default setting), and can be adjusted from 1 to 200 amps by turning the Encoder control.

To change start time, proceed to Section C. To save changes to TIG HF Impulse Start Amperage without changing start time, turn power Off.

CE Models Only



NOTE: Before accessing programmable TIG Impulse Start Amperage mode, be sure that all procedures and parameters are established. Especially, check for proper amperage setting (see Section 4-8). Parameter adjustment is limited while programmable TIG Impulse Start Amperage mode is active.

Welding cycle can be executed while in programmable start mode, but program parameters cannot be adjusted while in this mode.

1 Amperage Switch Pad

2 Encoder Control

To adjust TIG Impulse Start Amperage proceed as follows:

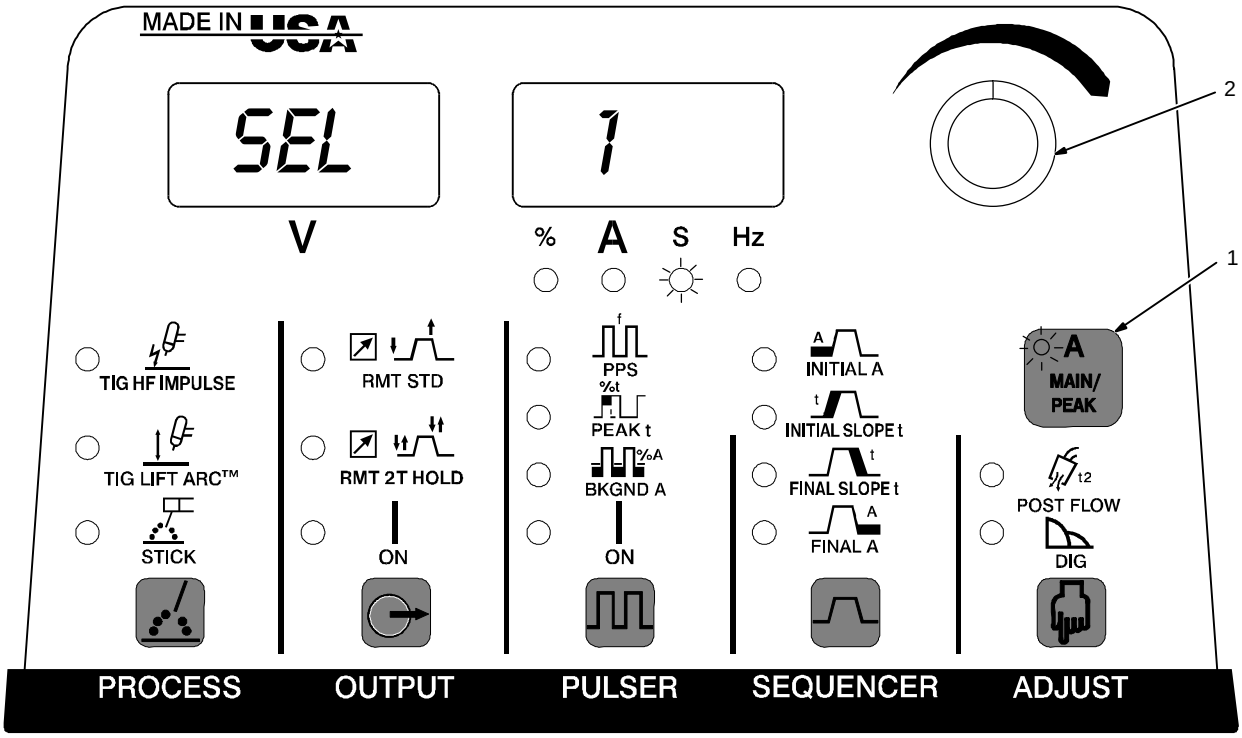
Press Amperage switch pad. Switch pad LED turns on, meter A LED turns on, and *{SEL} {25}* is displayed on meters. TIG Impulse LED is on. Note: If a remote mode and pulser functions are active, their respective LEDs will be illuminated.

The "*25*" displayed on the amps meter is DC start amps (it is also the factory default setting), and can be adjusted from 1 to 200 amps by turning the Encoder control.

To change start time, proceed to Section C. To save changes to TIG Impulse Start Amperage without changing start time, turn power Off.

C. Setting Programmable Start Time (All Models)

Non CE Models Only



NOTE: Before accessing programmable start time mode, be sure that all procedures and parameters are established. Especially, check for proper amperage setting (see Section 4-8). Parameter adjustment is limited while Programmable Start Time mode is active.

Welding cycle can be executed while in programmable start mode, but program parameters cannot be adjusted while in this mode.

A 1 Amperage Switch Pad

2 Encoder Control

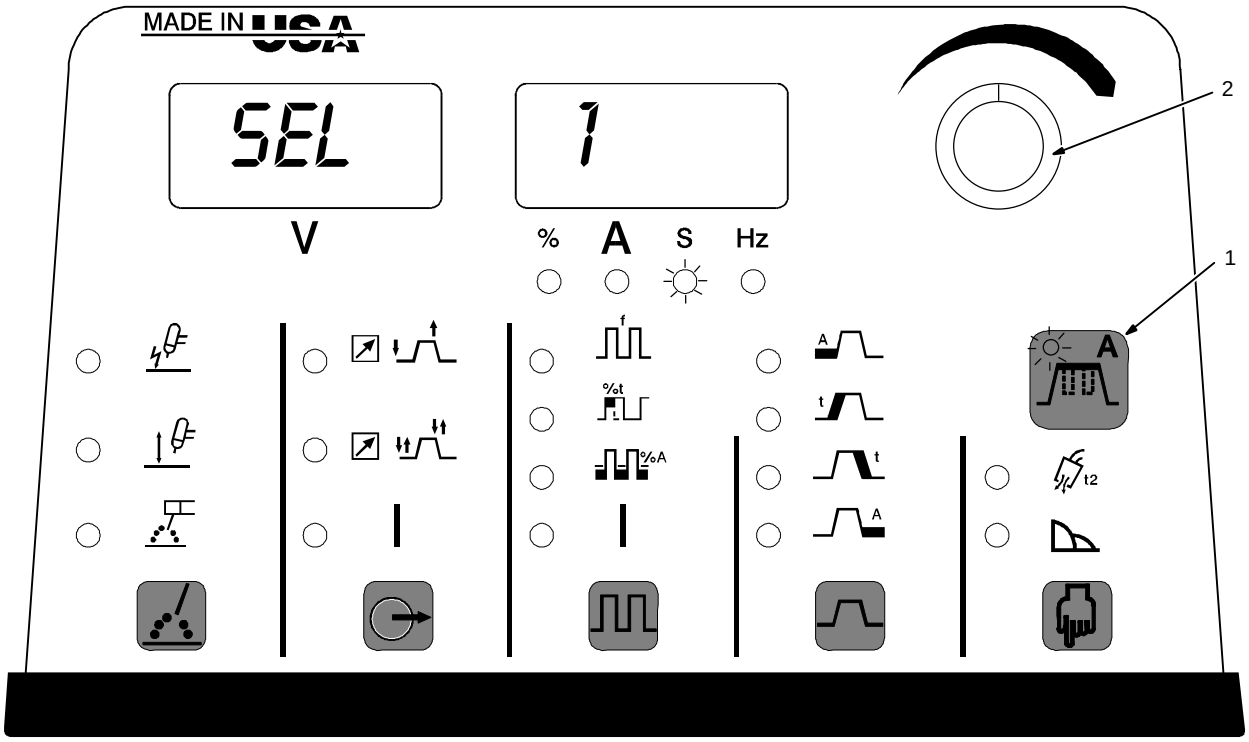
To adjust Programmable Start Time proceed as follows:

Press Amperage switch pad. Switch pad LED turns on, meter S LED turns on, and {SEL} {1} is displayed on meters.

The {1} displayed on the amps meter is the factory default setting, and can be adjusted from 1 to 200 milliseconds by turning the Encoder control.

To save changes, turn power Off.

CE Models Only



NOTE: Before accessing programmable start time mode, be sure that all procedures and parameters are established. Especially, check for proper amperage setting (see Section 4-8). Parameter adjustment is limited while Programmable Start Time mode is active.

Welding cycle can be executed while in programmable start mode, but program parameters cannot be adjusted while in this mode.

1 Amperage Switch Pad

2 Encoder Control

To adjust Programmable Start Time proceed as follows:

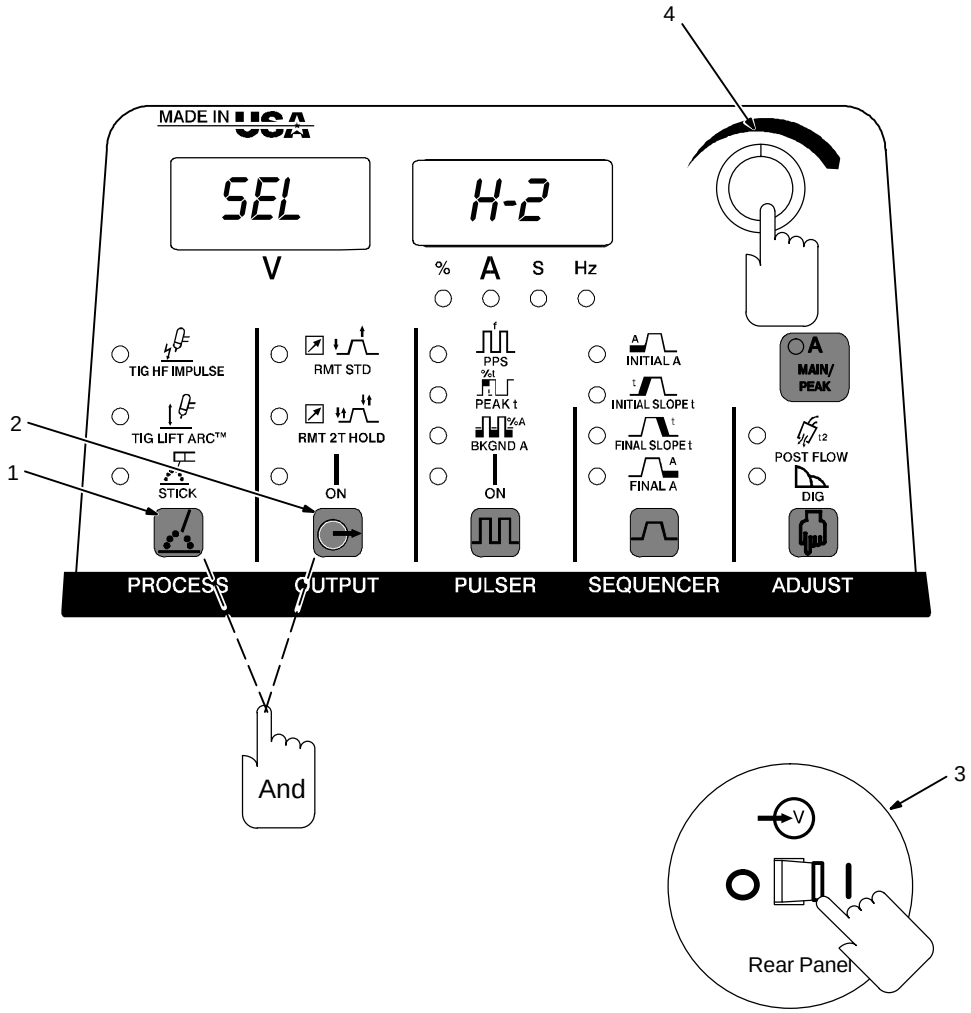
Press Amperage switch pad. Switch pad LED turns on, meter S LED turns on, and [SEL][1] is displayed on meters.

The [1] displayed on the amps meter is the factory default setting, and can be adjusted from 1 to 200 milliseconds by turning the Encoder control.

To save changes, turn power Off.

4-14. Reconfiguring 2T For 4T, 4T Momentary, Mini Logic Control, Or Spot (DX, LX And All CE Models)

Non CE Models Only



1 Process Switch Pad

2 Output Switch Pad

3 Power Switch

To reconfigure 2T, turn power off. Push and hold the Process and Output switch pads and turn On power switch. Hold switch pads for approximately 7 seconds (or until software version number _ _ _ _ _ _-_ clears, and display reads {SEL} {H-2}.

4 Encoder Control

Use Encoder to change functions. Active function will be displayed on amperage (right) meter.

5 Parameter Displays

The displays for the different functions will be as shown.

Press torch trigger or turn power Off to save setting.

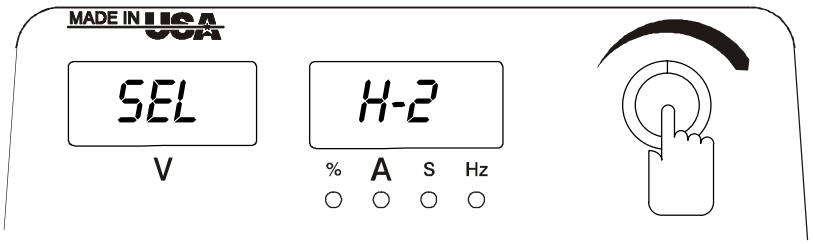
Proceed to Section 4-15 for 4T, {SEL} {H-4}, operation. Sequencer option required to reconfigure for 4T.

Proceed to Section 4-16 for Mini Logic, {SEL} {HAL}), operation. Sequencer option required to reconfigure for Mini Logic.

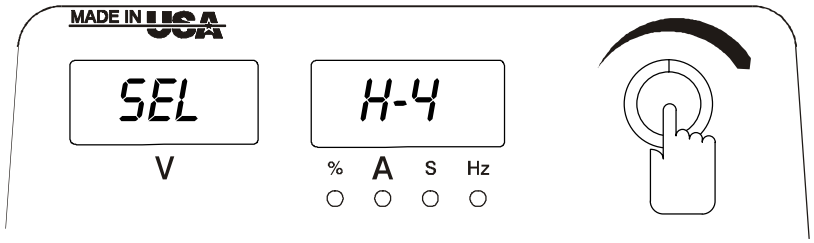
Proceed to Section 4-16 for 4T Momentary, {SEL} {HAE}, operation. Sequencer option required to reconfigure for 4T Momentary.

Proceed to Section 4-17 for Spot Control, {SEL} {SPO}, Operation.

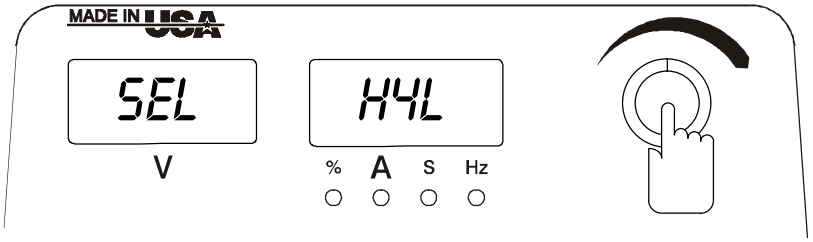
NOTE: After 2T has been reconfigured and one of the reconfigured functions is selected during normal operation, upon power up, H-4, HAL, HAE, or SPO will be displayed for 5 seconds as a reminder to the operator.



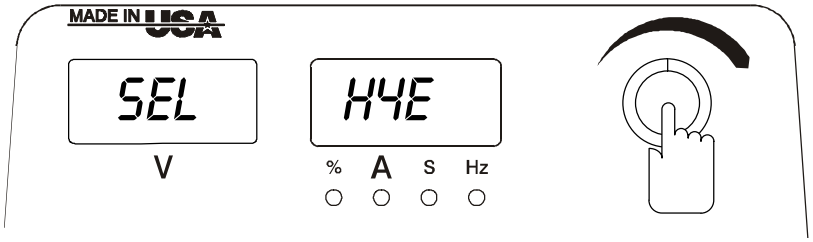
= 2T (See Section 4-7 for operation)



= 4T (See Section 4-15 for operation)

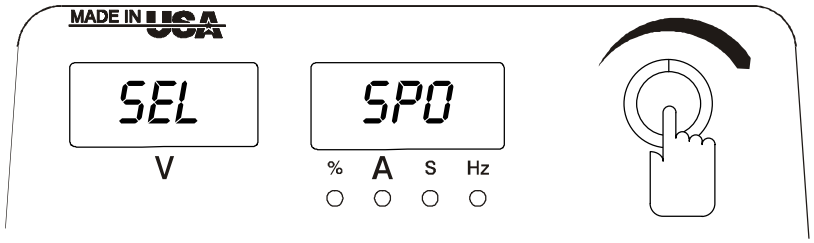


= Mini Logic (See Section 4-16 for operation)



= 4T Momentary

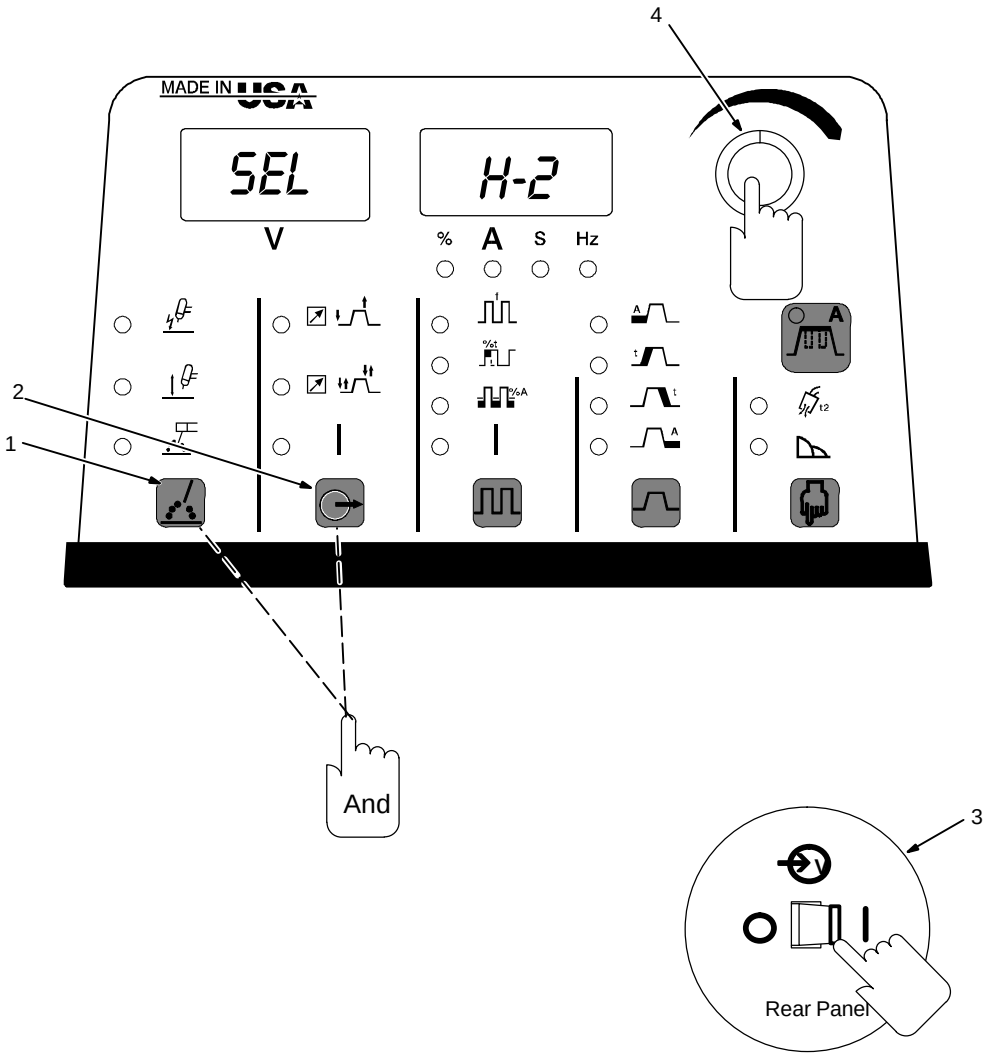
(See Section 4-16 for operation)



= Spot (See Section 4-17 for operation)

5

CE Models Only



1 Process Switch Pad

2 Output Switch Pad

3 Power Switch

To reconfigure 2T, turn power off. Push and hold the Process and Output switch pads and turn On power switch. Hold switch pads for approximately 7 seconds (or until software version number _ _ _ _ _ _-_clears, and display reads *{SEL} {H-2}*.

4 Encoder Control

Use Encoder to change functions. Active function will be displayed on amperage (right) meter.

5 Parameter Displays

The displays for the different functions will be as shown.

Press torch trigger or turn power Off to save setting.

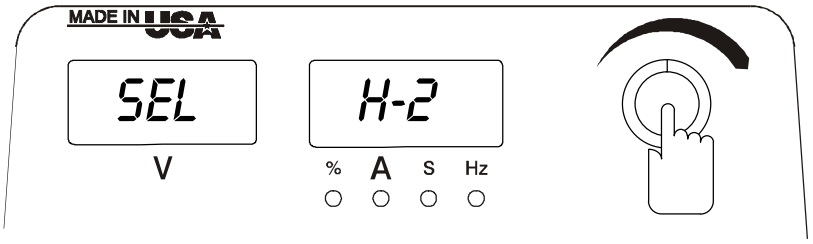
Proceed to Section 4-15 for 4T, *{SEL} {H-4}*, operation. Sequencer option required to reconfigure for 4T.

Proceed to Section 4-16 for Mini Logic, *{SEL} {MYL}*, operation. Sequencer option required to reconfigure for Mini Logic.

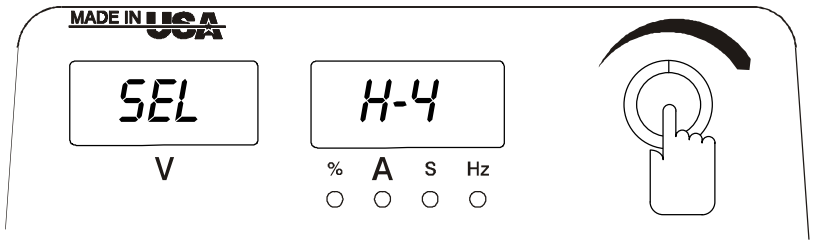
Proceed to Section 4-16 for 4T Momentary, *{SEL} {MYE}*, operation. Sequencer option required to reconfigure for 4T Momentary.

Proceed to Section 4-17 for Spot Control, *{SEL} {SPO}*, Operation.

NOTE: After 2T has been reconfigured and the 2T LED is on, of the reconfigured functions is selected during normal operation, upon power up, *H-4*, *MYL*, *MYE*, or *SPO* will be displayed for 5 seconds as a reminder to the operator.

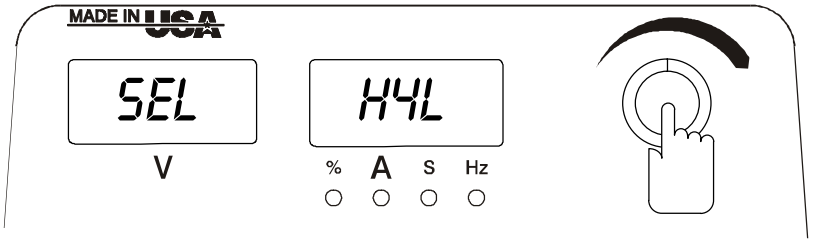


= 2T (See Section 4-7 for operation)

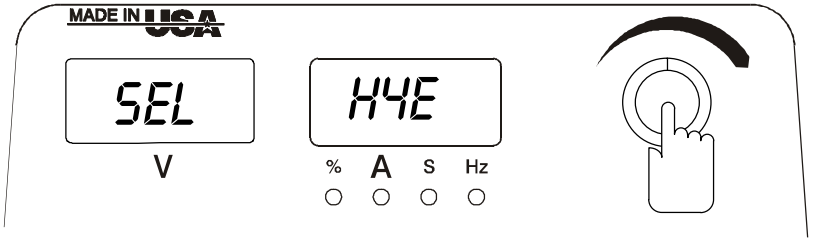


= 4T (See Section 4-15 for operation)

5

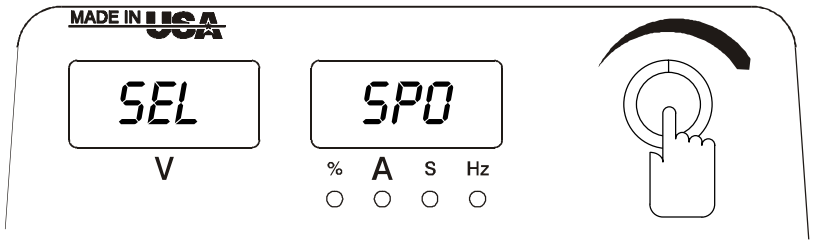


= Mini Logic (See Section 4-16 for operation)



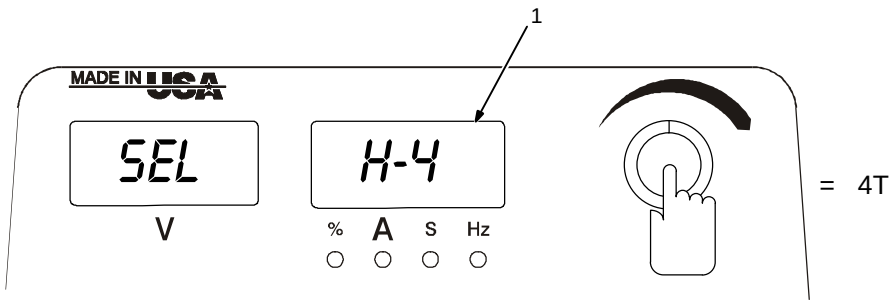
= 4T Momentary

(See Section 4-16 for operation)



= Spot (See Section 4-17 for operation)

4-15. 4T Specific Trigger Method (DX, LX And All CE Models)



1 4T (Specific Trigger Operation)

Sequencer is required to reconfigure for 4T.

Select 4T according to Section 4-14.

Torch trigger operation is as shown.

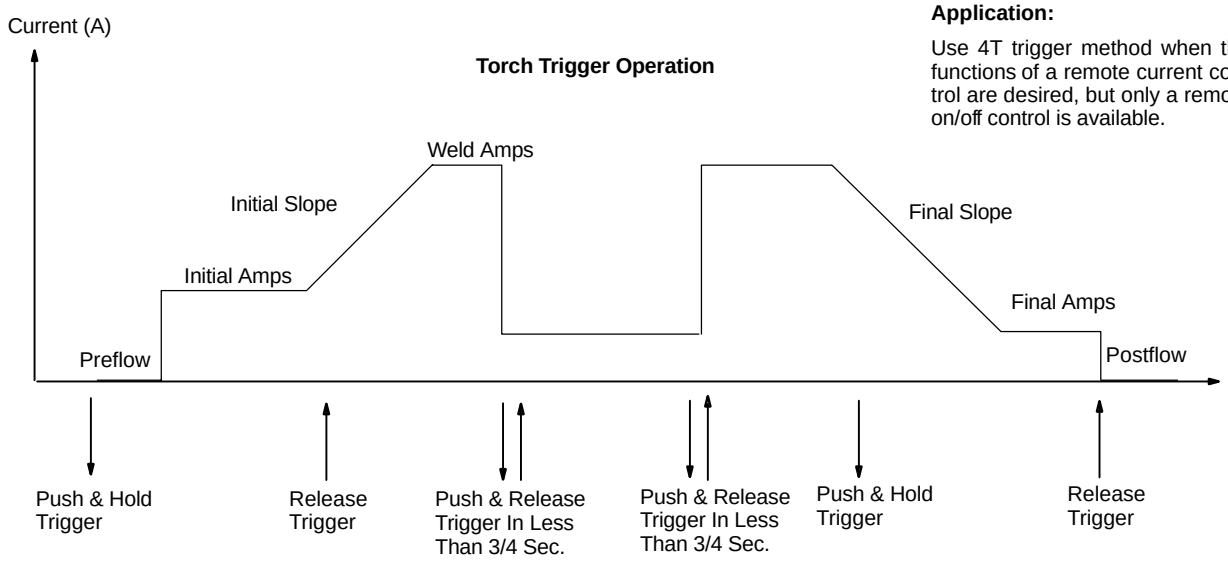
While in 4T mode, there is a function available during the main weld sequence that allows the operator to toggle between weld current and final current without breaking the arc.

NOTE: When a remote switch is connected to the welding power source, only trigger input is functional. Amperage is controlled by the welding power source.

Application:

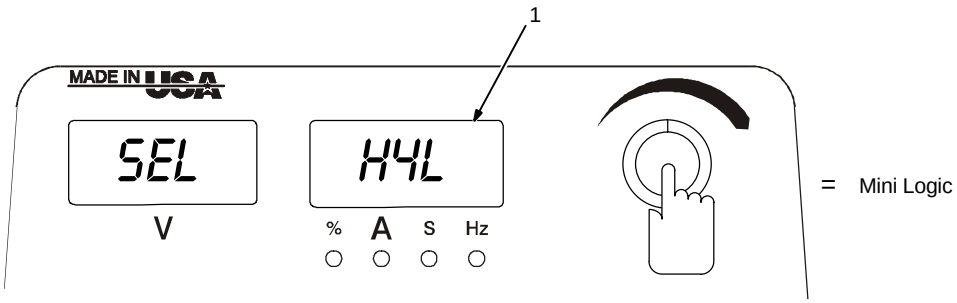
Use 4T trigger method when the functions of a remote current control are desired, but only a remote on/off control is available.

Torch Trigger Operation



NOTE: If arc is broken and trigger is depressed, or trigger is still depressed after postflow time is complete, HLP-10 will be displayed (see Section 5-3).

4-16. Mini Logic Operation (DX, LX And All CE Models)



1 Mini Logic Meter Display

Sequencer option required to reconfigure for Mini Logic.

Select Mini Logic according to Section 4-14.

Torch trigger operation is as shown.

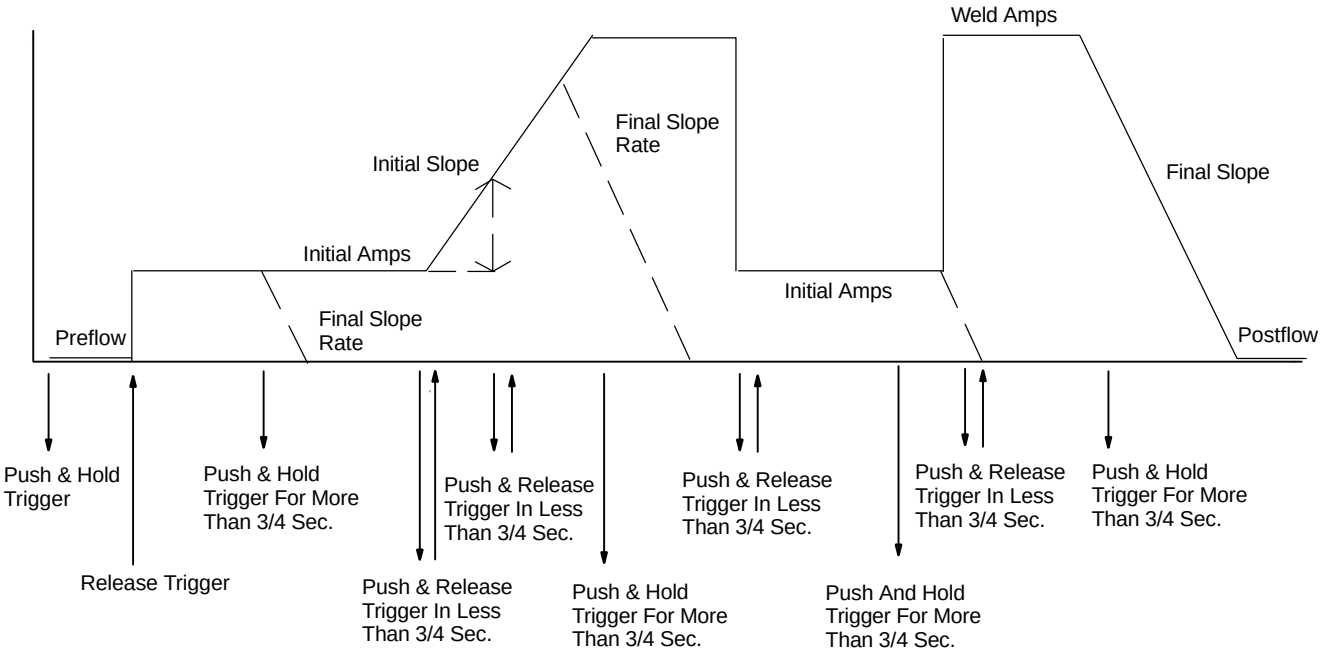
During Mini Logic welding operation, the weld current can be toggled between the initial amps level and the weld amps or slope level by pressing and releasing the torch trigger in less than 3/4 seconds.

During Mini Logic, Final Amperage is not available. Final slope will always slope to minimum amperage and end the cycle.

NOTE: When a remote switch is connected to the welding power source, only trigger input is functional. Amperage is controlled by the welding power source.

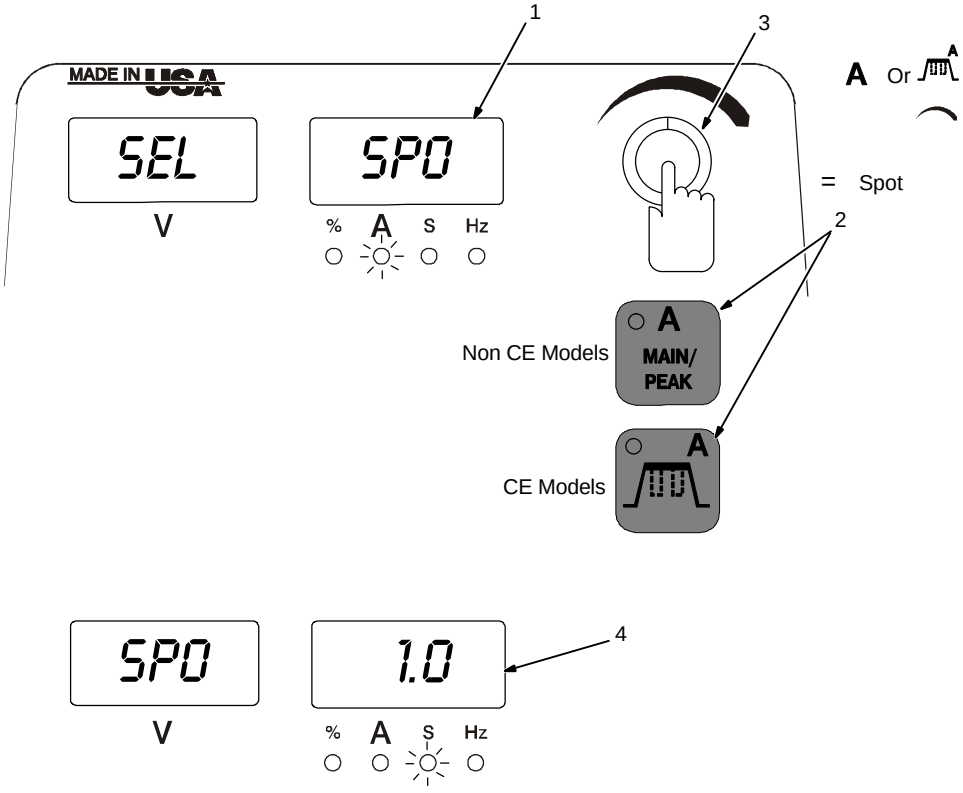
Application: This ability to change current levels without either initial slope or final slope, gives the operator the opportunity to adjust filler metal without breaking the arc.

Torch Trigger Operation


Weld Amps
Final Slope Rate
Initial Slope
Final Slope
Initial Amps
Initial Amps
Final Slope Rate
Preflow
Postflow
Push & Hold Trigger
Push & Hold Trigger For More Than 3/4 Sec.
Push & Release Trigger In Less Than 3/4 Sec.
Push & Release Trigger In Less Than 3/4 Sec.
Push & Release Trigger In Less Than 3/4 Sec.
Push & Hold Trigger For More Than 3/4 Sec.
Release Trigger
Push & Release Trigger In Less Than 3/4 Sec.
Push & Hold Trigger For More Than 3/4 Sec.
Push And Hold Trigger For More Than 3/4 Sec.

NOTE: If arc is broken and trigger is depressed, or trigger is still depressed after postflow time is complete, HLP-10 will be displayed (see Section 5-3).

4-17. Spot Control Operation (All Models)



1 Spot Function Display

Select Spot function according to Section 4-14.

2 Amperage Switch Pad

3 Encoder Control

Set spot parameters as follows: Press Amperage switch pad once (A LED turns on) and turn Encoder to set spot amperage.

4 Spot Time Display

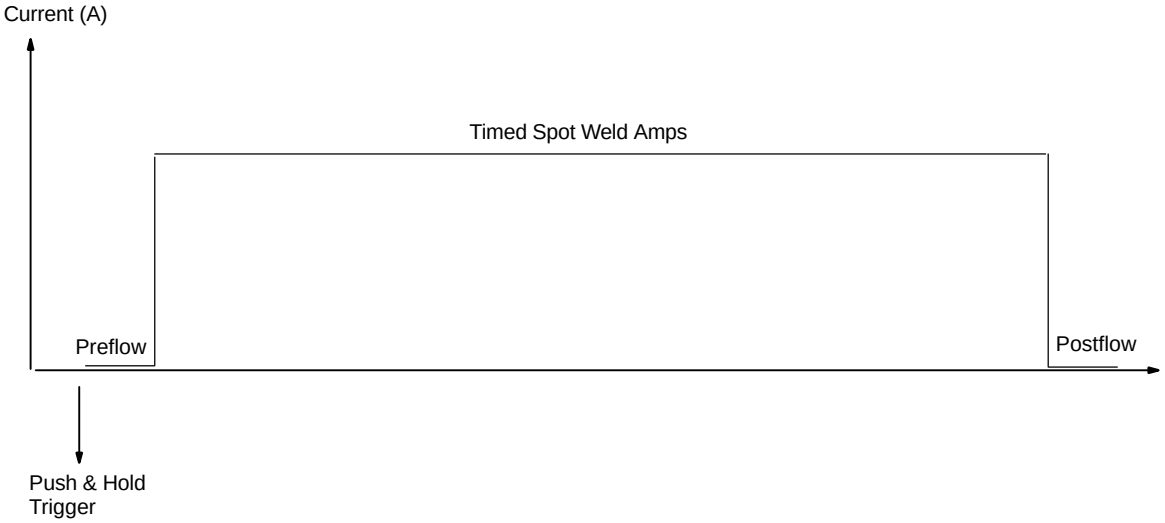
Press Amperage switch pad again, (S LED lights) and turn Encoder to set spot time (.1–25 seconds). Factory default setting is 1 second.

NOTE: While in Spot Control, Sequencer settings will be ignored, and will not be programmable.

NOTE: While in Spot Control, when a remote switch is connected to the welding power source, only trigger input is functional. Amperage is controlled by the welding power source.

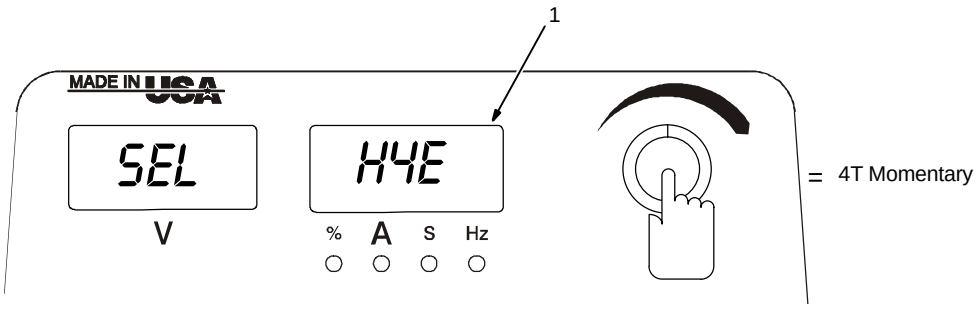
Torch trigger operation is as shown.

Application: To provide a timed weld. Also for tacking, and thin sheet joining.



NOTE: If arc is broken and trigger is depressed, or trigger is still depressed after postflow time is complete, HLP-10 will be displayed (see Section 5-3).

4-18. 4T Momentary Operation (DX, LX And All CE Models)



1 4T Momentary Display

Select 4T Momentary according to Section 4-14.

If unit is equipped with Sequence Controls, a 4T Momentary trigger method is available.

4T Momentary torch trigger operation is as shown.

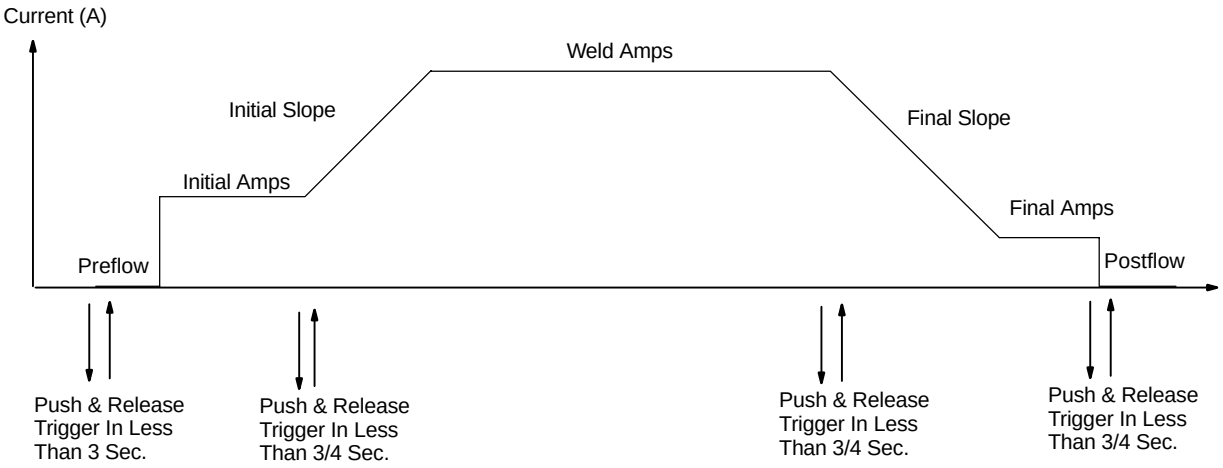
While in 4T Momentary mode, once the operator toggles out of weld current and begins final slope, toggling again will break the arc and go to postflow.

NOTE: When a remote switch is connected to the welding power source, only trigger input is functional. Amperage is controlled by the welding power source.

Application:

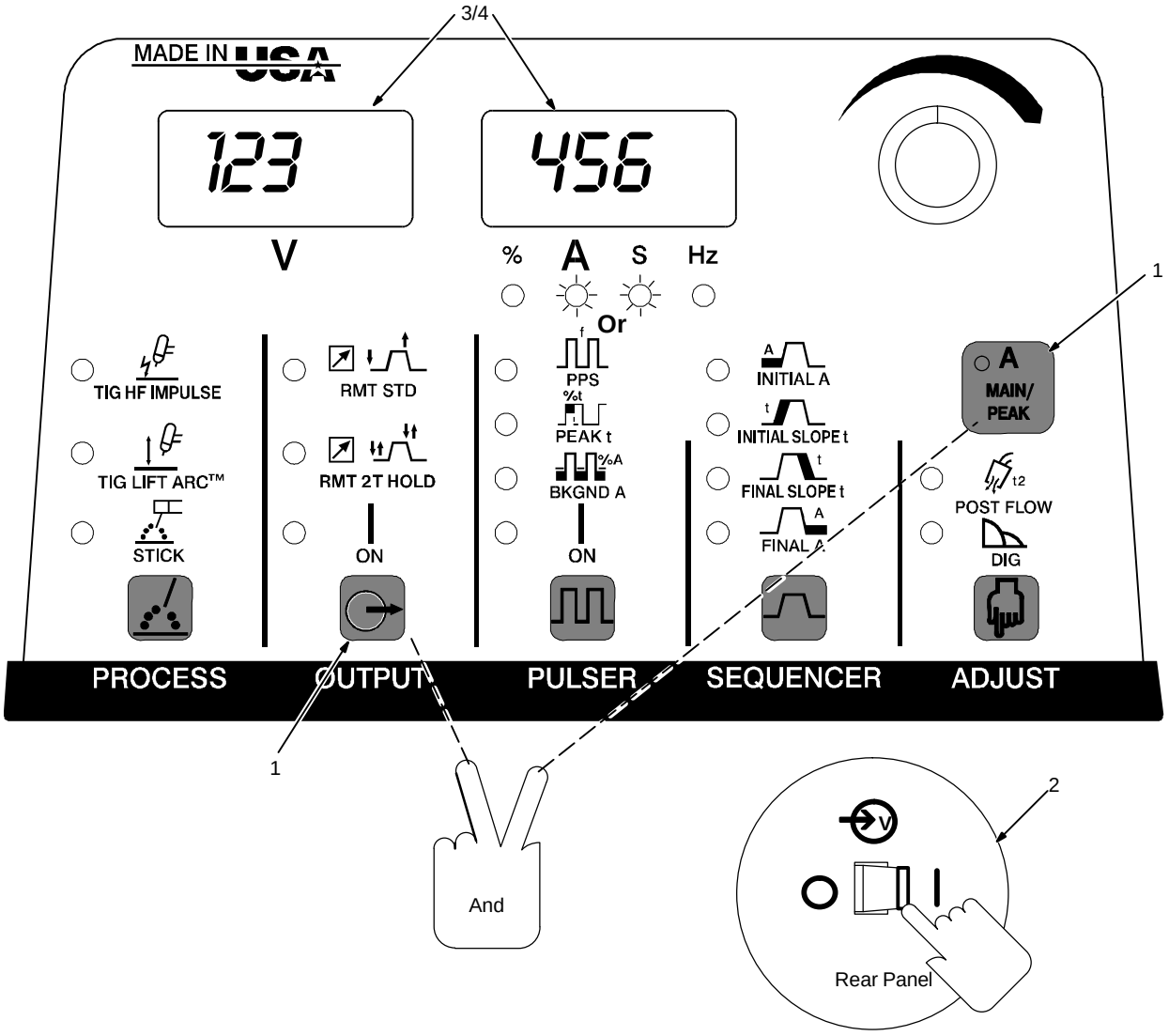
Use 4T Momentary trigger method when the functions of a remote current control are desired, but only a remote on/off control is available.

Select 4T Momentary trigger method according to Section 4-14.


Current (A)
Weld Amps
Initial Slope
Final Slope
Initial Amps
Final Amps
Preflow
Postflow
Push & Release Trigger In Less Than 3 Sec.
Push & Release Trigger In Less Than 3/4 Sec.
Push & Release Trigger In Less Than 3/4 Sec.
Push & Release Trigger In Less Than 3/4 Sec.

NOTE: If torch trigger is held more than 3 seconds, operation reverts to Remote Trigger (Standard) mode. If arc is broken and trigger is depressed, HLP-10 will be displayed (see Section 5-3).

4-19. Arc Timer/Counter Display (All Models)



A

V

1 Output And Amperage Controls

2 Power Switch

To display the arc timer/counter, turn power off. Push and hold Output and Amperage control switch pads, and turn On Power switch. Hold switch pads for approximately 7 seconds (or until software version number _ _ _ _ _ _-_clears displays).

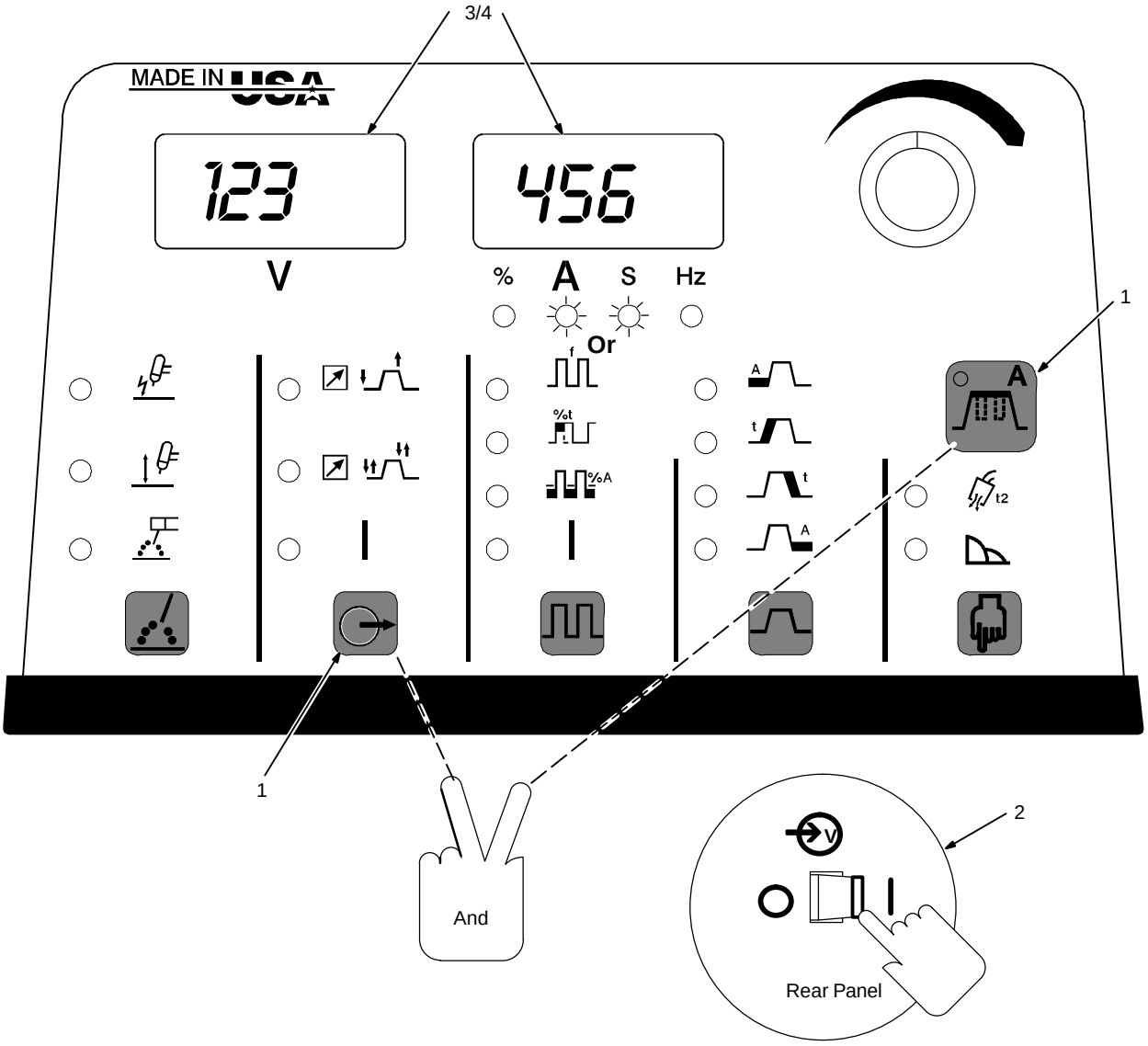
3 Arc Timer Display

Upon power up as described above, the S LED will turn on, and arc time will be displayed for 5 seconds as *(000 000)* to *(999 999)*. The first four numbers indicate hours, and the last two numbers indicate minutes. Arc time shown in example is read as 1,234 hours and 56 minutes. Maximum arc time is 9,999 hours and 59 minutes.

4 Arc Counter

After 5 seconds, the A LED turns on, and the arc counter will be displayed for the next 5 seconds as *(000 000)* to *(999 999)*. The maximum arc cycle count is 999 999.

CE Models



1 Output And Amperage Controls

2 Power Switch

To display the arc timer/counter, turn power off. Push and hold Output and Amperage control switch pads, and turn On Power switch. Hold switch pads for approximately 7 seconds (or until software version number _ _ _ _ _ _-_clears displays).

3 Arc Timer Display

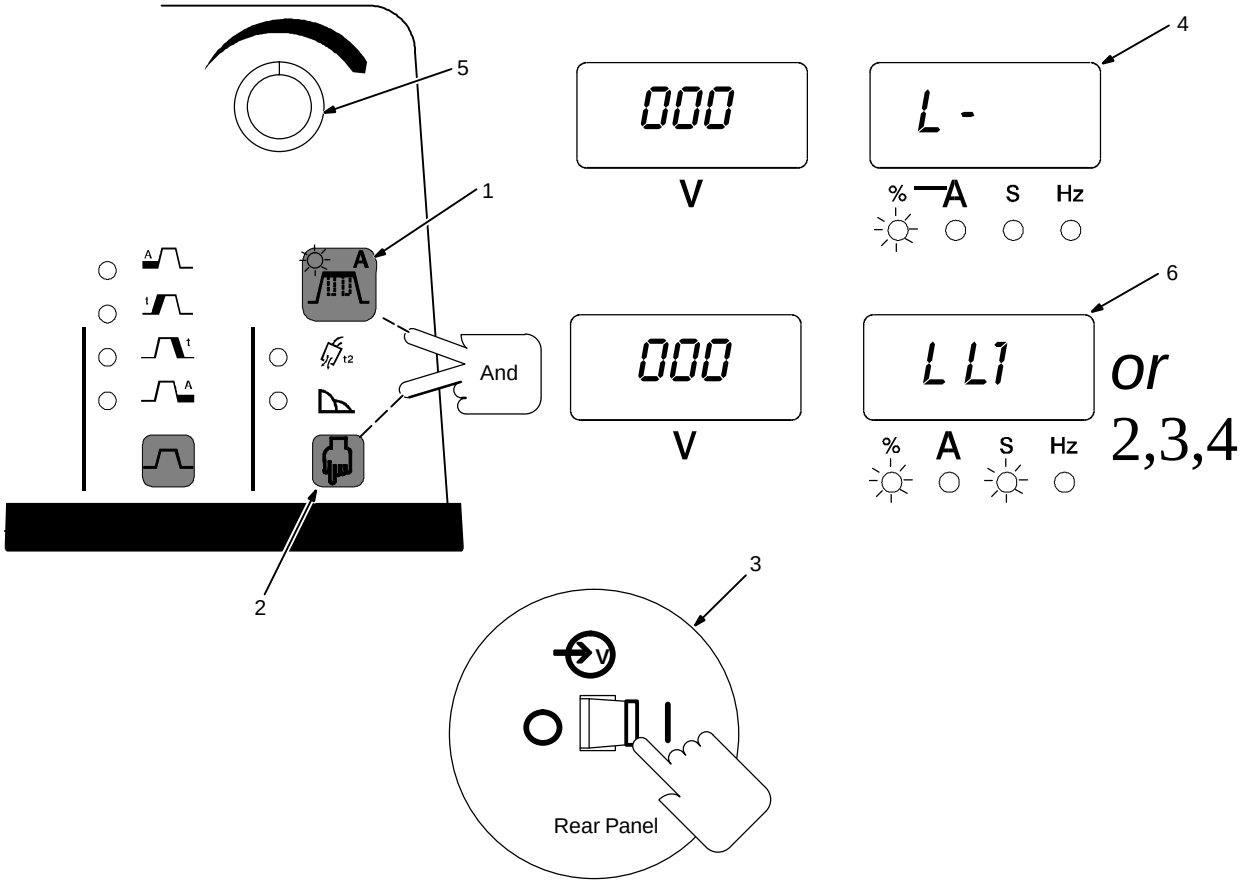
Upon power up as described above, the S LED will turn on, and arc time will be displayed for 5 seconds as *{000 000}* to *{999 999}*. The first four numbers indicate hours, and the last two numbers indicate minutes. Arc time shown in example is read as 1,234 hours and 56 minutes. Maximum arc time is 9,999 hours and 59 minutes.

4 Arc Counter

After 5 seconds, the A LED turns on, and the arc counter will be displayed for the next 5 seconds as *{000 000}* to *{999 999}*. The maximum arc cycle count is 999 999.

4-20. Lockout Functions

A. Accessing Lockout Capability



See Section 4-1 for explanation of controls referred to in all of Section 4-20.

There are four (1–4) different lockout levels. Each successive level allows the operator more flexibility.

NOTE: Before activating lockout levels, be sure that all procedures and parameters are established. Parameter adjustment is limited while lockout levels are active.

1 Amperage (A) Switch Pad

2 Adjust Switch Pad

3 Power Switch

To access lockout screens, press and hold the Amperage and Adjust switch pads, and turn On power switch. Hold switch pads for approximately 7 seconds (or until software version number _ _ _ _ _ _-_clears displays).

4 Lockout Off

Upon power up as described, the % and Amperage (A) switch pad LED's light, and the display will be as shown for a lockout off condition.

5 Encoder Control

To turn On the lockout feature, proceed as follows:

Pressing Amperage (A) switch pad will toggle between the % and S LED's. Toggle switch pad until % LED is on.

Turn Encoder control to select a three digit lockout number. Number will appear on the voltage (left) meter. Select any number from *(001)* thru *(999)*. **IMPORTANT:** remember this three digit number, as you will need it to turn the lockout feature off.

Toggle Amperage (A) switch pad to light the S LED. You may now select a lockout level.

There are four lockout levels available. Turn Encoder control to access a lockout level (see Sections B and/or C for lockout level descriptions).

6 Lockout On

Press torch trigger or turn Off power to complete lockout On sequence.

NOTE: Setting a three digit lockout number of *(000)*, or setting a lockout level of *(L--)* will cause a lockout off condition.

To turn Off the lockout feature, proceed as follows:

To access lockout screens, press and hold the Amperage (A) and Adjust switch pads, and turn On power switch. Hold switch pads for approximately 7 seconds (or until software version number _ _ _ _ _ _-_clears meters).

Upon power up as described, the % and Amperage (A) switch pad LED's will turn on, and the meter display will be as shown for a lockout on (see callout 6) condition.

Use Encoder control to enter the same three digits that were used to turn on the lockout feature.

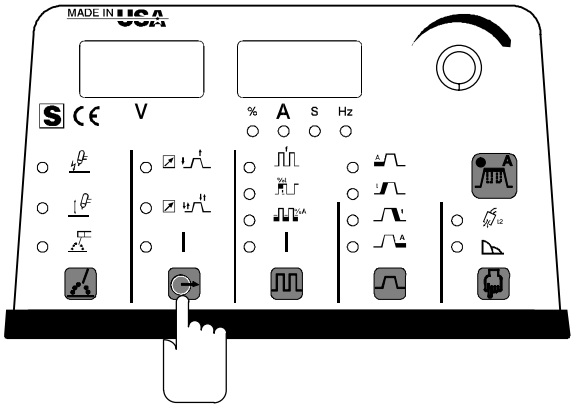
Press the Amperage (A) switch pad. The % LED will turn off, and the S LED's will light. The amperage (right) meter display will change to *(L--)*. The lockout feature is now off.

NOTE: Setting a three digit lockout number of *(000)*, or setting a lockout level of *(L--)* will also cause a lockout off condition.

Press torch trigger or turn Off power to complete lock out Off sequence.

B. Lockout Levels

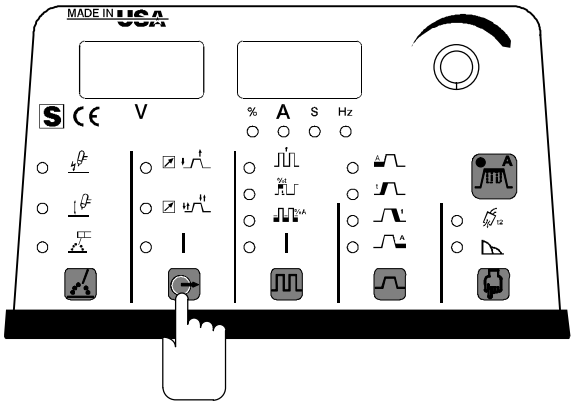
Level 1



Use Output Switch Pad To

Select A Trigger Method

For The TIG Process

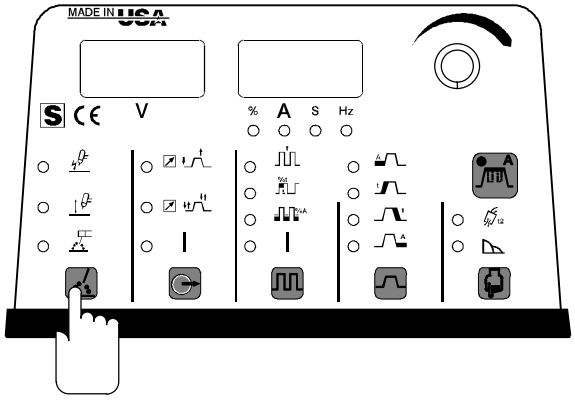


Use Output Switch Pad To

Select A Trigger Method

For The Stick Process

Level 2



Select Stick, Or Lift-Arc,
Or HF Start

Process Selection

Level 1

NOTE: Before activating lock out levels, be sure that all procedures and parameters are established. Parameter adjustment is limited while lock out levels are active.

NOTE: Remote amperage control is not available in level 1.

TIG Output Selection

If either the TIG Impulse HF or TIG Lift Arc process (see Section 4-7) was active when lockout level 1 was activated, the operator can choose between RMT STD (Remote Standard) or RMT 2T HOLD (Remote 2T Hold). The On function is also available if TIG Lift Arc was active.

If RMT 2T was reconfigured (see Section 4-14) prior to lockout level 1 activation, the reconfigured output mode (4T, 4T momentary, mini logic, or spot) is available to the operator instead of RMT 2T.

Stick Output Selection

If the Stick process was active when lockout level 1 was activated, the operator can choose between RMT STD or On.

Process selection may not be changed in lockout level 1. If the operator tries to change his process selection, the amperage (right) meter will display *L-1* as a reminder.

The parameters for the remaining functions may be viewed by pressing the appropriate switch pads. If the Encoder is turned while viewing parameters, *L-1* will be displayed, and parameters will not change. If unit is equipped with a pulser and the pulser is off, *L-1* will be displayed as a reminder that the pulser is off.

Level 2

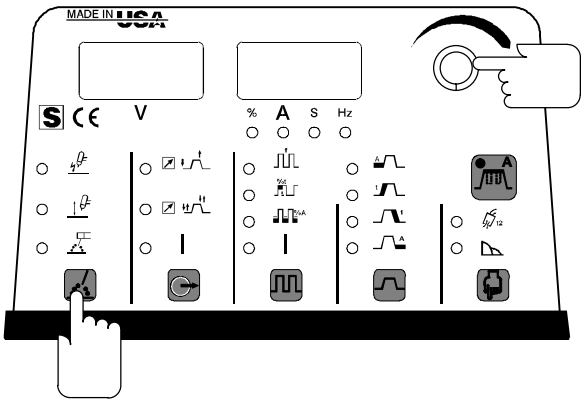
NOTE: Before activating lockout levels, be sure that all procedures and parameters are established. Parameter adjustment is limited while lockout levels are active.

NOTE: Remote amperage control is not available in level 2.

Includes all the functions of level 1 plus **Process Selection** (see Section 4-4).

C. Lockout Levels (Continued)

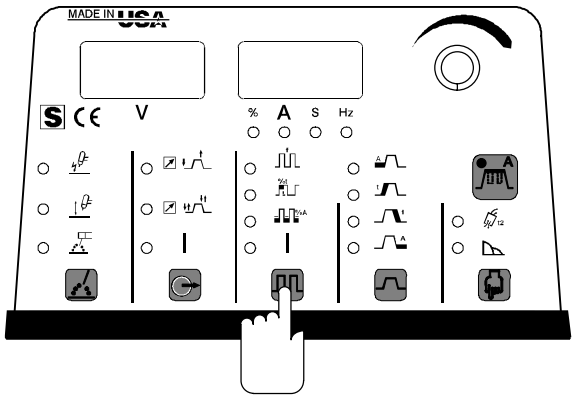
Level 3



Use Encoder Control To Adjust Amperage +/– 10% Of Preset Value.

Select Stick Or TIG

+/– 10 % Amperage Adjust Control

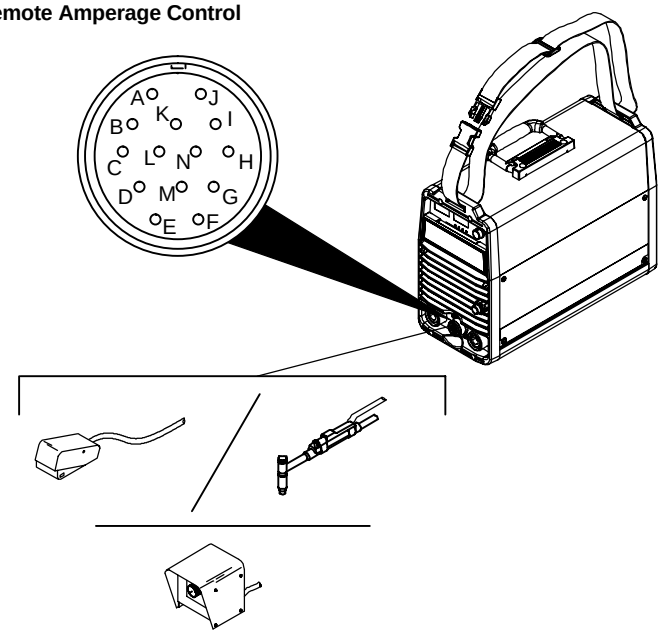


Turn Pulser Control On/Off

Pulser On/Off Control

Level 4

Remote Amperage Control



Level 3

NOTE: Before activating lockout levels, be sure that all procedures and parameters are established. Parameter adjustment is limited while lockout levels are active.

NOTE: Remote amperage control is not available in level 3.

Includes all the functions of levels 1 and 2 plus the following:

+/– 10% adjustment of preset TIG or Stick Weld Amps

Select desired process, TIG or Stick, and use Encoder control to adjust amperage +/– 10% of preset amperage value, up to the limits of the machine. If operator tries to go beyond the +/– 10%, the amperage (right) meter will display *LL3* as a reminder.

Pulser ON/Off Control

Gives operator the ability to turn on/off the Pulser control.

Level 4

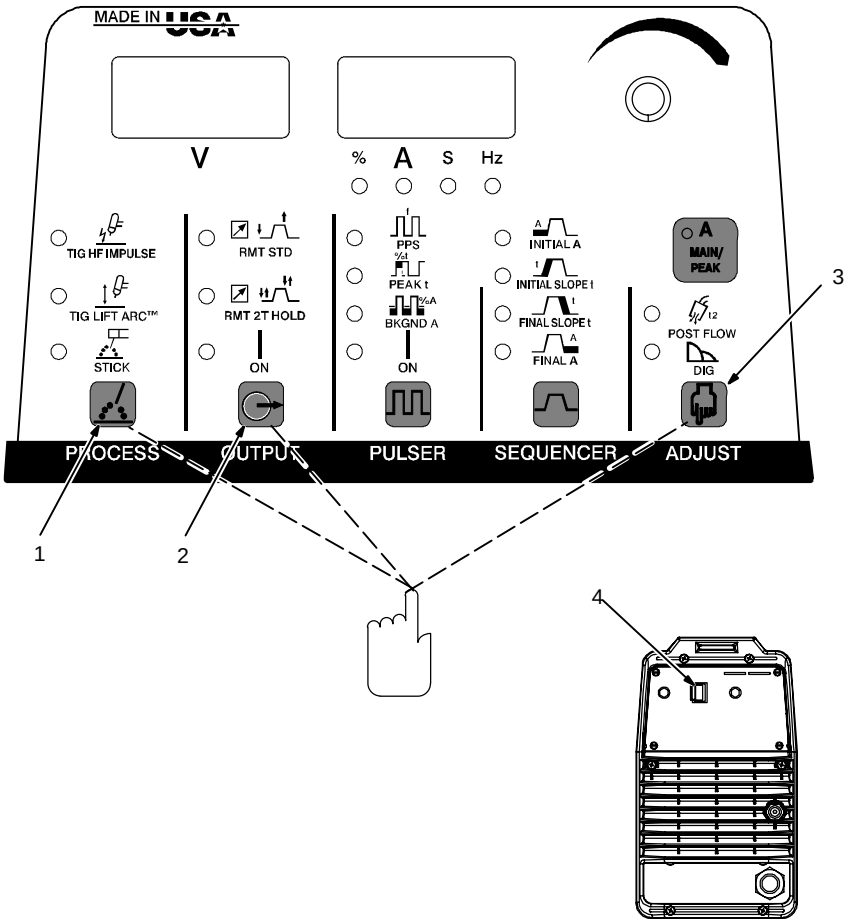
NOTE: Before activating lockout levels, be sure that all procedures and parameters are established. Parameter adjustment is limited while lockout levels are active.

Includes all the functions of levels 1, 2, and 3 plus the following:

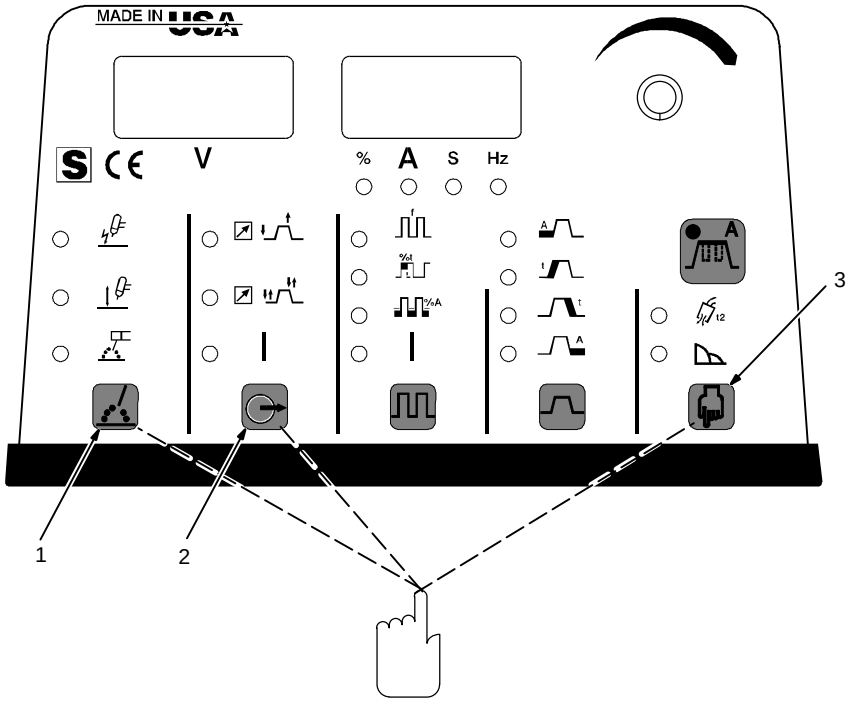
Remote Amperage Control

Allows operator to use remote amperage control if desired. Remote control operates from minimum to maximum of preset amperage value. Connect remote control device according to Section 3-6.

4-21. Resetting Unit To Factory Default Settings (All Models)



CE Models

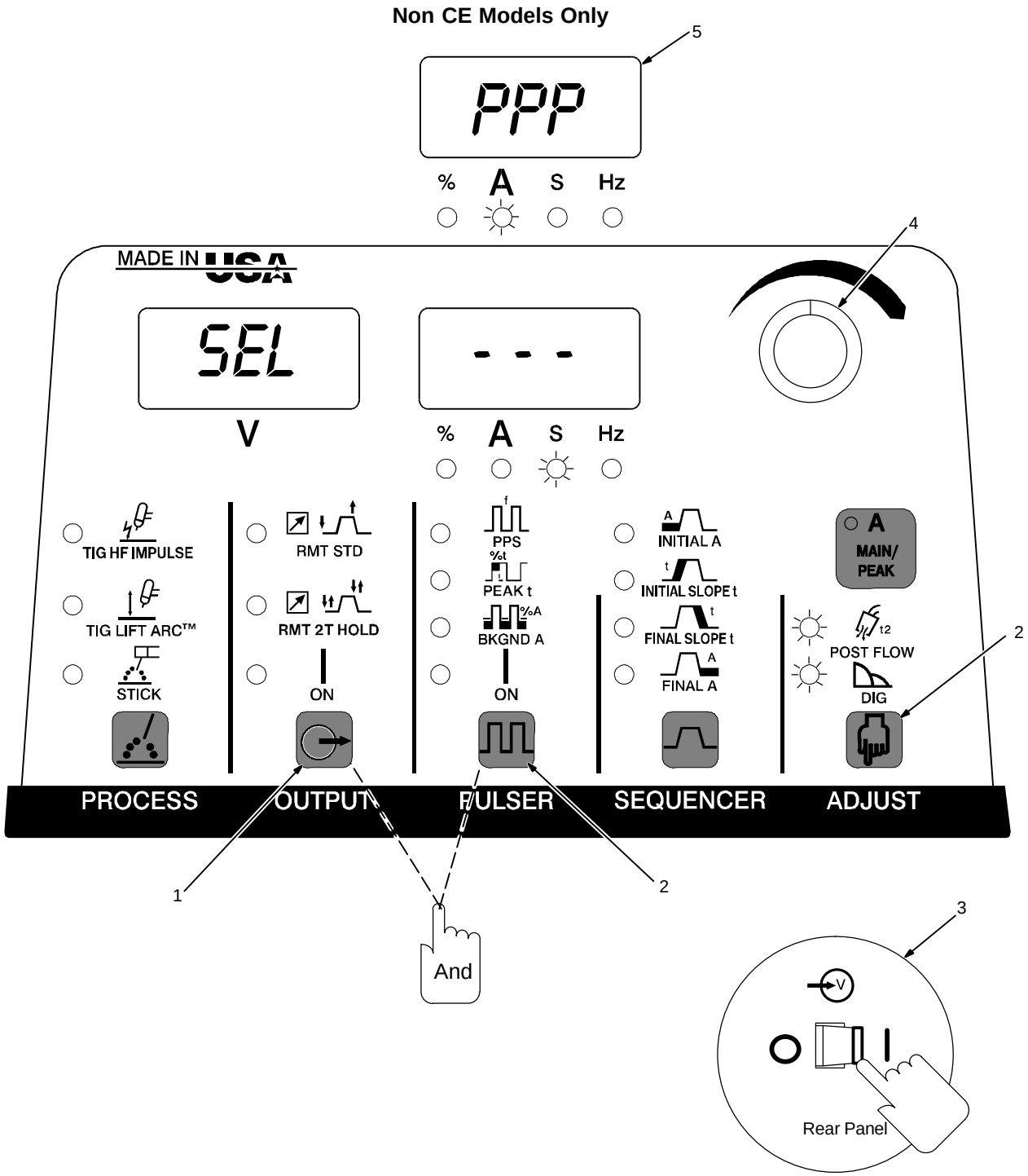


1 Process Switch Pad
2 Output Switch Pad
3 Adjust Switch Pad
4 Power Switch

To reset all welding power source functions to original factory settings, turn power off. Push and hold the Process, Output and Adjust switch pads and turn On power switch. Hold switch pads for approximately 7 seconds (or until software version number _ _ _ _ _ _-_clears displays).

Note: In order to reset unit to factory default settings, Lockout function must be turned off (see Section 4-20).

4-22. Setting Unit To Display PPP While Pulse Welding



1 Output Switch Pad

2 Pulser Switch Pad

3 Power Switch

Turn power off. Push and hold the Output and Pulser switch pads and turn On power switch. Hold switch pads for approximately 7 seconds (or until software version number _ _ _ _ _ _-_clears, and meters display *{SEL} {--- }*. Upon power up as described, the A LED under the right display and the Pulser On LED illuminate.

4 Encoder Control

5 PPP Meter Display

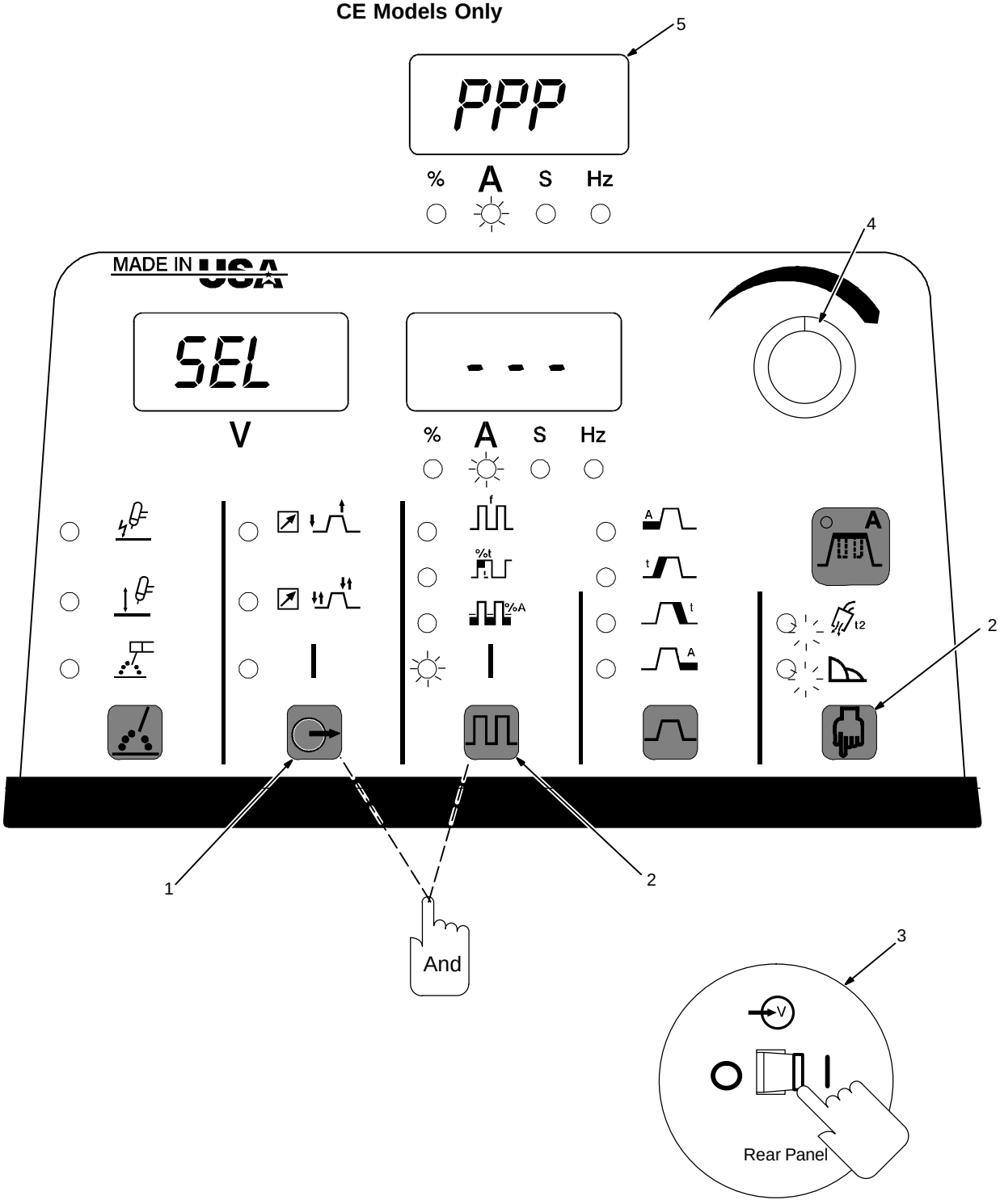
Turn Encoder to change between standard and *{PPP}* meter display.

When the *{PPP}* meter display feature is active while pulse welding, the *{PPP}* will be displayed on the right meter display, and the Meter Hold feature is disabled.

The *{PPP}* meter display feature will not effect the normal amperage display or Meter Hold capabilities when in a non-pulse welding mode.

Press torch trigger or turn off power to save setting and end this set-up.

CE Models Only



1 Output Switch Pad

2 Pulser Switch Pad

3 Power Switch

Turn power off. Push and hold the Output and Pulser switch pads and turn On power switch. Hold switch pads for approximately 7 seconds (or until software version number _ _ _ _ _ _-_clears, and meters display *{SEL} {--- }*. Upon power up as described, the A LED under the right display and the Pulser On LED illuminate.

4 Encoder Control

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Turn Encoder to change between standard and *{PPP}* meter display.

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The *{PPP}* meter display feature will not effect the normal amperage display or Meter Hold capabilities when in a non-pulse welding mode.

Press torch trigger or turn off power to save setting and end this set-up.

SECTION 5 – MAINTENANCE AND TROUBLESHOOTING

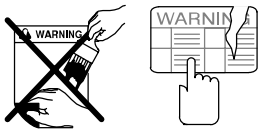
5-1. Routine Maintenance

▲ **Disconnect power before maintaining.**

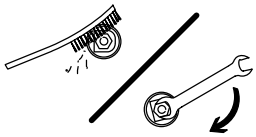
☞ *Maintain more often during severe conditions.*

3 Months

Replace unreadable labels.



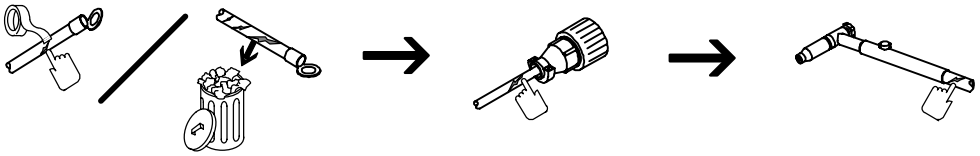
Clean and tighten weld terminals.



Replace Damaged Gas Hose

3 Months

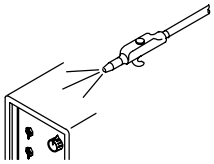
Repair Or Replace Cracked Cables And Cords



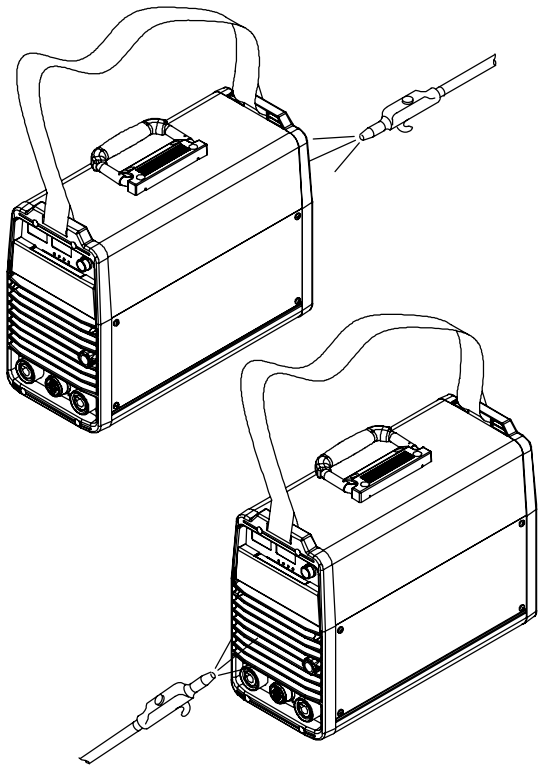
6 Months

▲ **Do not remove case when blowing out inside of unit (see Section 5-2) .**

Blow out inside. During heavy service clean monthly.



5-2. Blowing Out Inside Of Unit

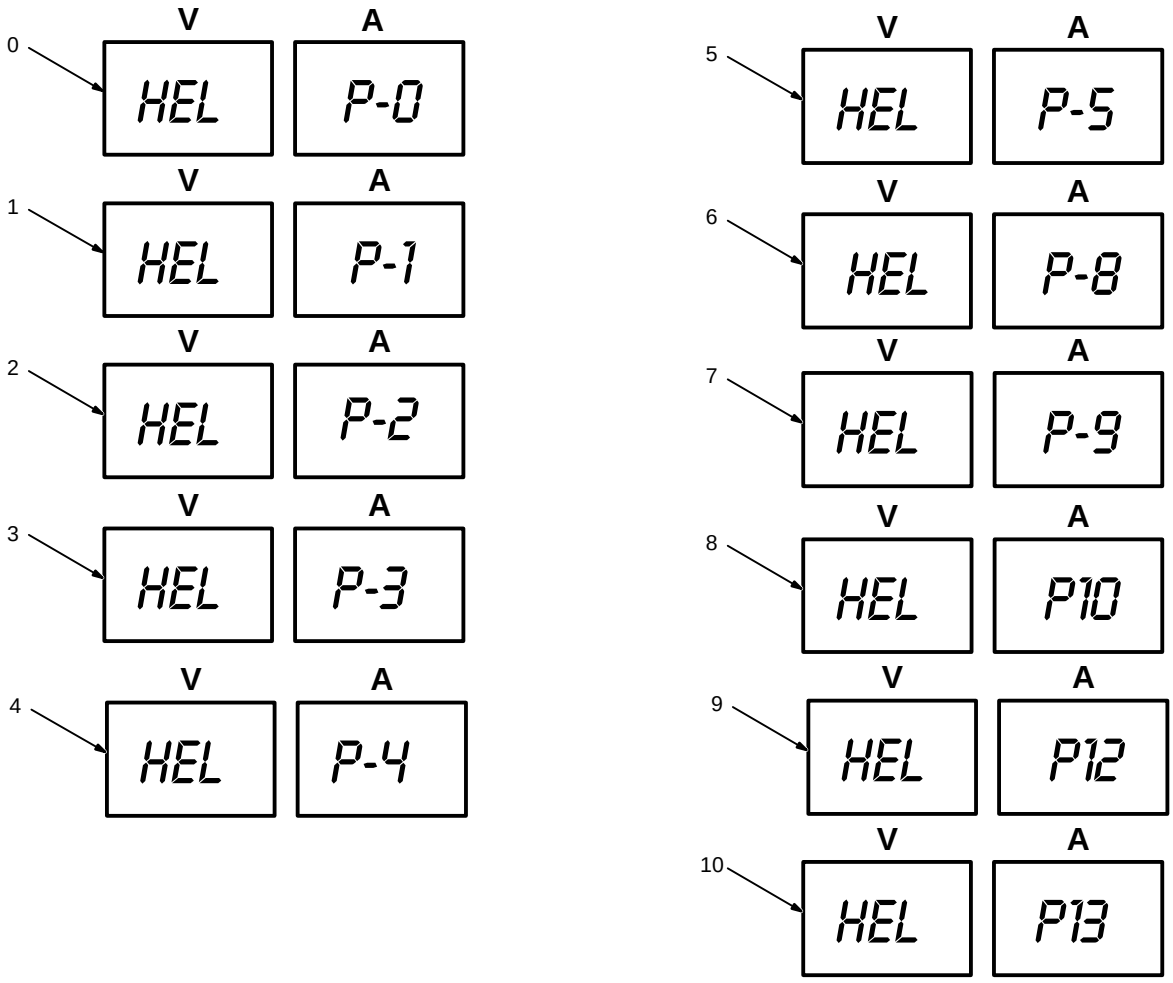


▲ **Do not remove case when blowing out inside of unit.**

To blow out unit, direct airflow through front and back louvers as shown.

ST-802 451

5-3. Voltmeter/Ammeter Help Displays



☞ *All directions are in reference to the front of the unit. All circuitry referred to is located inside the unit.*

0 Help 0 Display

Indicates a short in the thermal protection circuitry located on the bottom heat sink. Contact a Factory Authorized Service Agent if this display is shown.

1 Help 1 Display

Indicates a malfunction in the primary power circuit caused by an overcurrent condition in the primary IGBT switching circuit. Contact a Factory Authorized Service Agent if this display is shown.

2 Help 2 Display

Indicates an open in the thermal protection circuitry located on the bottom heat sink. Contact a Factory Authorized Service Agent if this display is shown.

3 Help 3 Display

Indicates the bottom heat sink has overheated. The unit has shut down to allow the fan to cool it (see Section 3-3). Operation will continue when the unit has cooled.

4 Help 4 Display

Indicates an open in the thermal protection circuitry located on the top heat sink. Contact a Factory Authorized Service Agent if this display is shown.

5 Help 5 Display

Indicates the top heat sink has overheated. The unit has shut down to allow the fan to cool it (see Section 3-3). Operation will continue when the unit has cooled.

6 Help 8 Display

Indicates a malfunction in the secondary power circuit of the unit. There is a high open circuit condition. Contact a Factory Authorized Service Agent if this display is shown.

7 Help 9 Display

Indicates a short in the thermal protection circuitry located on the top heat sink. Contact a Factory Authorized Service Agent if this display is shown.

8 Help 10 Display

Indicates torch trigger is depressed. Release trigger to continue.

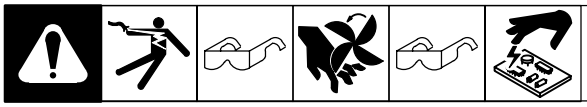
9 Help 12 Display

Indicates an improper set-up. You are trying to make an adjustment that is not allowed.

10 Help 13 Display (LX Models Only)

Output enable signal broken causing weld output to stop, but gas continues to flow if Post Flow function is active or gas control on 10-pin is On (see Section 3-7).

5-4. Troubleshooting



Trouble	Remedy
No weld output; unit completely inoperative.	Place line disconnect switch in On position (see Section 3-14).
	Check and replace line fuse(s), if necessary, or reset circuit breaker (see Section 3-14).
	Check for proper input power connections (see Section 3-14).
No weld output; meter display On.	If using remote control, be sure correct process is enabled to provide output control at Remote 14 receptacle (see Section 3-6 as applicable).
	Input voltage outside acceptable range of variation (see Section 3-13).
	Check, repair, or replace remote control.
	Unit overheated. Allow unit to cool with fan On (see Section 3-3).
Erratic or improper weld output.	Use proper size and type of weld cable (see Section 3-5).
	Clean and tighten all weld connections (see Section 3-5).
Fan not operating.	Check for and remove anything blocking fan movement.
	Have Factory Authorized Service Agent check fan motor.
Wandering arc	Use proper size tungsten (see Section 8).
	Use properly prepared tungsten (see Section 8).
	Reduce gas flow rate (see Section 3-8).
Tungsten electrode oxidizing and not remaining bright after conclusion of weld.	Shield weld zone from drafts.
	Increase postflow time (see Section 4-1).
	Check and tighten all gas fittings (see Section 3-8).
	Water in torch. Refer to torch manual.

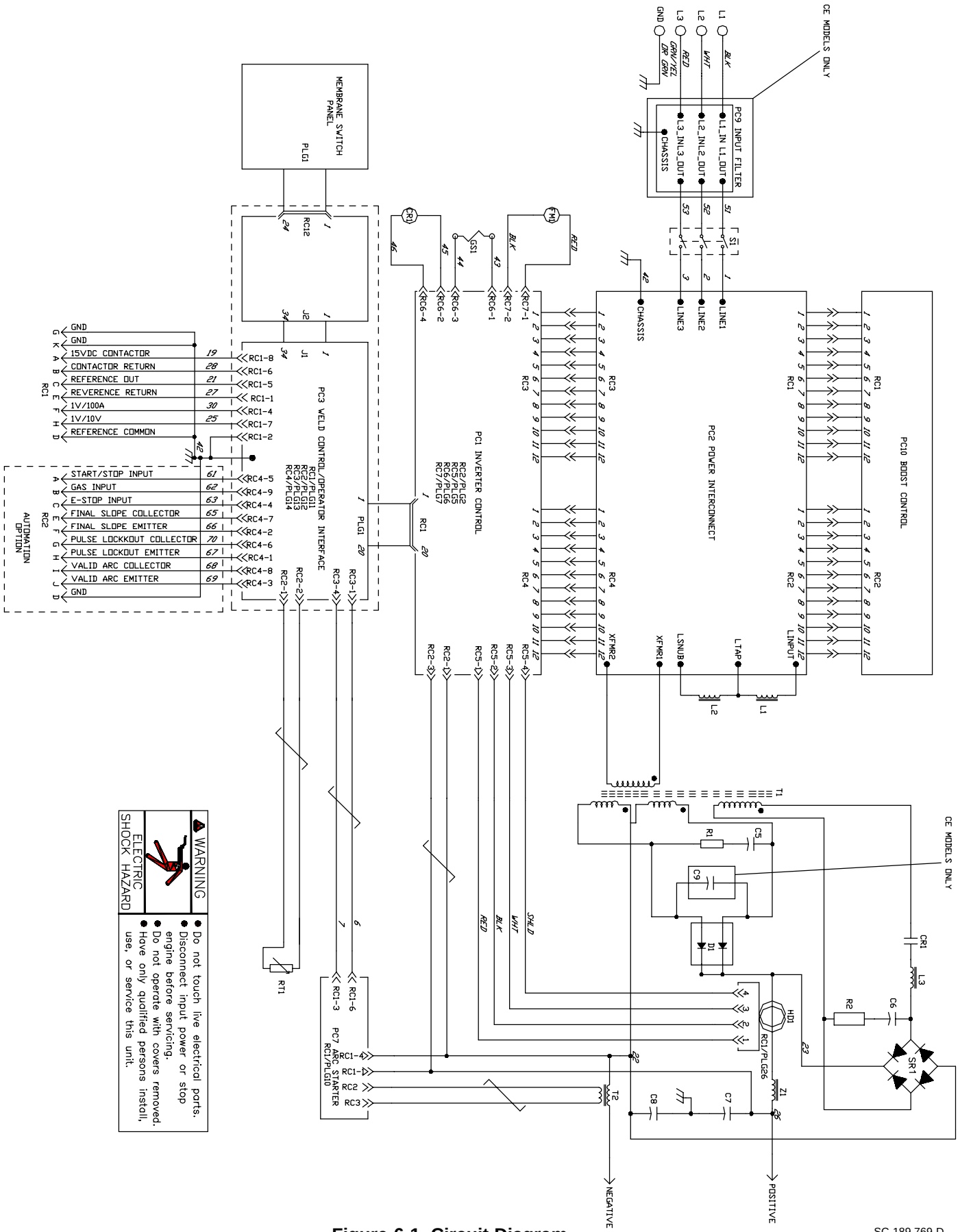
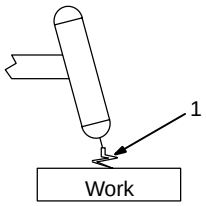


Figure 6-1. Circuit Diagram

SC-189 769-D

SECTION 7 – HIGH FREQUENCY

7-1. Welding Processes Requiring High Frequency



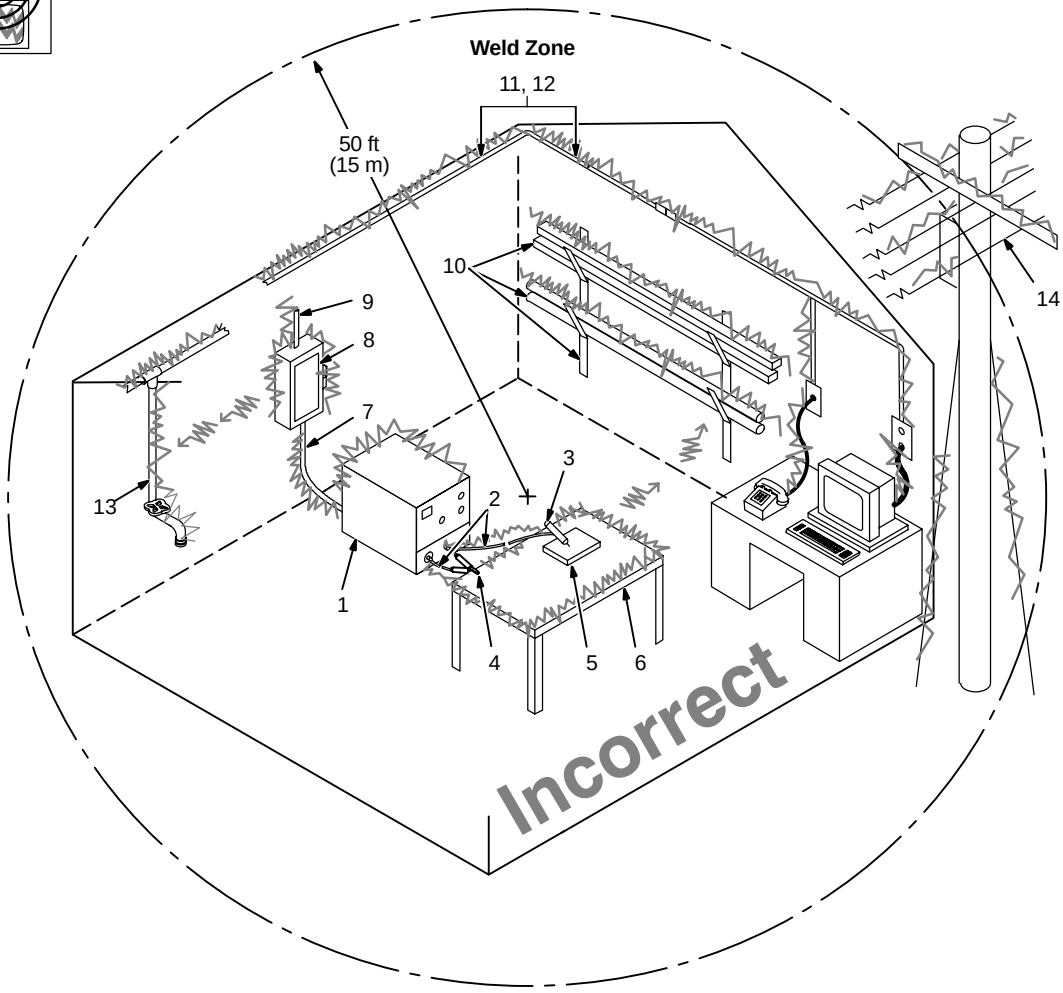
TIG

1 High-Frequency Voltage

TIG – helps arc jump air gap between torch and workpiece and/or stabilize the arc.

high_freq 12/96 – S-0693

7-2. Incorrect Installation



Sources of Direct High-Frequency Radiation

1 High-Frequency Source (welding power source with built-in HF or separate HF unit)
2 Weld Cables
3 Torch
4 Work Clamp
5 Workpiece
6 Work Table

Sources of Conduction of High Frequency

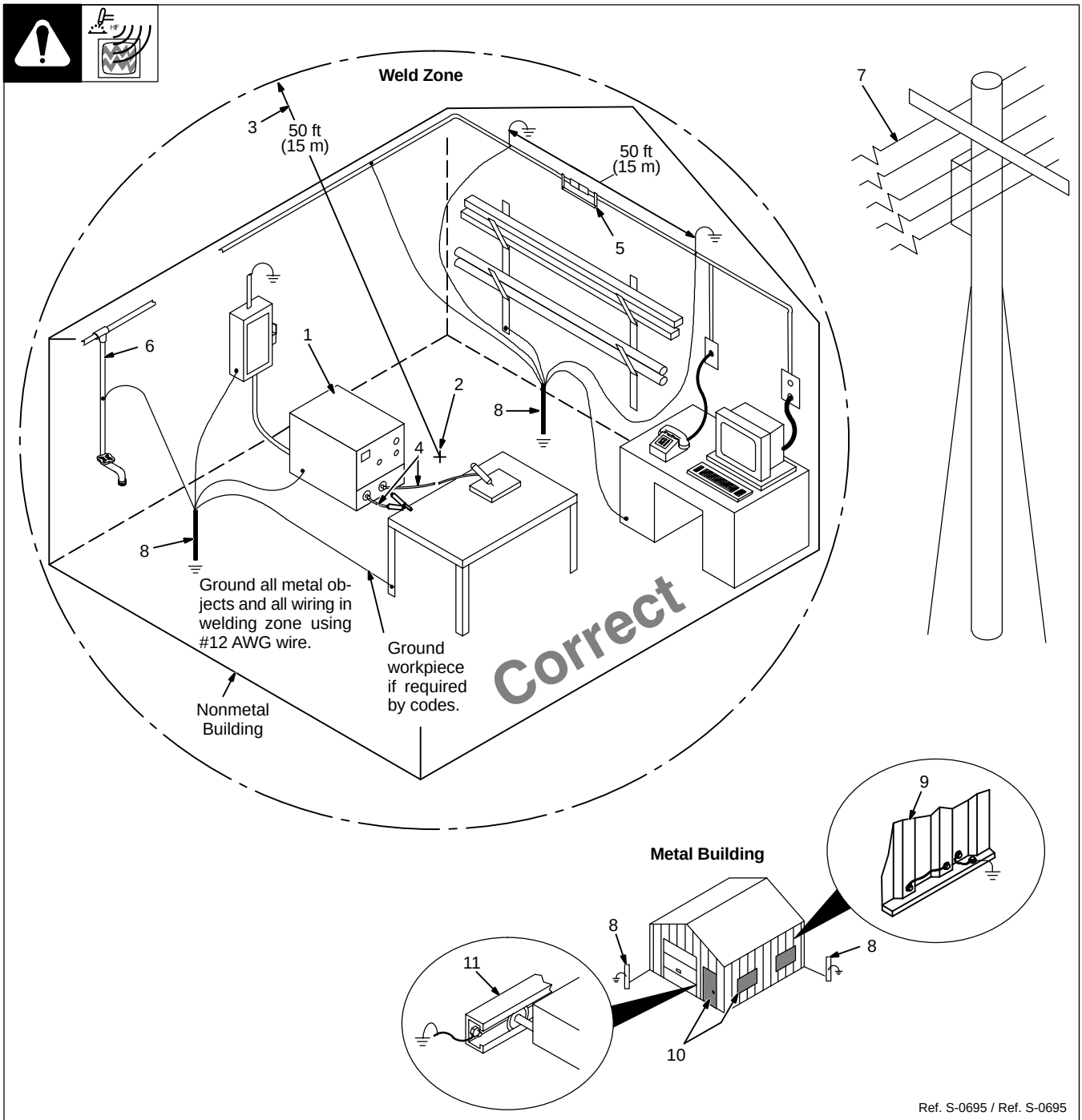
7 Input Power Cable
8 Line Disconnect Device
9 Input Supply Wiring

Sources of Reradiation of High Frequency

10 Ungrounded Metal Objects
11 Lighting
12 Wiring
13 Water Pipes and Fixtures
14 External Phone and Power Lines

S-0694

7-3. Correct Installation



Ref. S-0695 / Ref. S-0695

1 High-Frequency Source (welding power source with built-in HF or separate HF unit)

Ground metal machine case, work output terminal, line disconnect device, input supply, and worktable.

2 Center Point of Welding Zone

Midpoint between high-frequency source and welding torch.

3 Welding Zone

A circle 50 ft (15 m) from center point in all directions.

4 Weld Output Cables

Keep cables short and close together.

5 Conduit Joint Bonding and Grounding

Electrically join (bond) all conduit sections using copper straps or braided wire. Ground conduit every 50 ft (15 m).

6 Water Pipes and Fixtures

Ground water pipes every 50 ft (15 m).

7 External Power or Telephone Lines

Locate high-frequency source at least 50 ft (15 m) away from power and phone lines.

8 Grounding Rod

Consult the National Electrical Code for specifications.

Metal Building Requirements

9 Metal Building Panel Bonding Methods

Bolt or weld building panels together, install copper straps or braided wire across seams, and ground frame.

10 Windows and Doorways

Cover all windows and doorways with grounded copper screen of not more than 1/4 in (6.4 mm) mesh.

11 Overhead Door Track

Ground the track.

SECTION 8 – SELECTING AND PREPARING TUNGSTEN ELECTRODE

gtaw 7/97

NOTE ☞ *For additional information, see your distributor for a handbook on the Gas Tungsten Arc Welding (GTAW) process.Wear clean gloves to prevent contamination of tungsten electrode.*

8-1. Selecting Tungsten Electrode

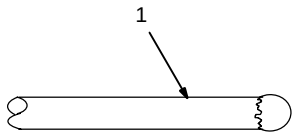
Electrode Diameter	Amperage Range - Gas Type♦ - Polarity			
	DC – Argon – Electrode Negative/Straight Polarity	DC – Argon – Electrode Positive/Reverse Polarity	AC – Argon – Using High Frequency	AC – Argon – Balanced Wave Using High Freq.
2% Thorium Alloyed Tungsten (Red Band)				
.010”	Up to 25	*	Up to 20	Up to 15
.020”	15-40	*	15-35	5-20
.040”	25-85	*	20-80	20-60
1/16”	50-160	10-20	50-150	60-120
3/32”	135-235	15-30	130-250	100-180
1/8”	250-400	25-40	225-360	160-250
5/32”	400-500	40-55	300-450	200-320
3/16”	500-750	55-80	400-500	290-390
1/4”	750-1000	80-125	600-800	340-525

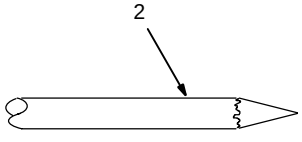
♦ Typical argon shielding gas flow rates are 15 to 35 cfh (cubic feet per hour).

*Not Recommended.

The figures listed are intended as a guide and are a composite of recommendations from American Welding Society (AWS) and electrode manufacturers.

8-2. Safety Information About Tungsten





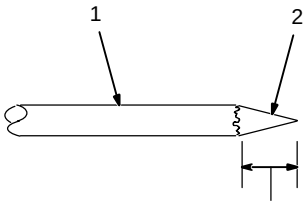
▲ **Grinding the tungsten electrode produces dust and flying sparks which can cause injury and start fires. Use local exhaust (forced ventilation) at the grinder or wear an approved respirator. Read MSDS for safety information. Consider using tungsten containing ceria, lanthana, or yttria instead of thoria. Grinding dust from thoriated electrodes contains low-level radioactive material. Properly dispose of grinder dust in an environmentally safe way. Wear proper face, hand, and body protection. Keep flammables away.**

1 Tungsten Electrode With Balled End

2 Pointed Tungsten Electrode

Ref. S-0161

8-3. Preparing Tungsten For AC Or DC Electrode Negative (DCEN) Welding

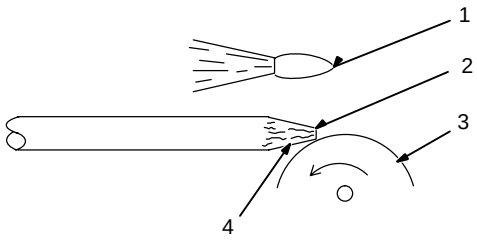


2-1/2 Times
Electrode Diameter

1 Tungsten Electrode

2 Tapered End

Grind end of tungsten on fine grit, hard abrasive wheel before welding. Do not use wheel for other jobs or tungsten can become contaminated causing lower weld quality.



Ideal Tungsten Preparation – Stable Arc

1 Stable Arc

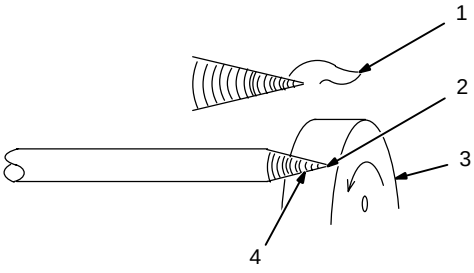
2 Flat

Diameter of this flat determines amperage capacity.

3 Grinding Wheel

Grinding wheel should be dedicated to grinding tungsten only.

4 Straight Ground



Wrong Tungsten Preparation – Wandering Arc

1 Arc Wander

2 Point

3 Grinding Wheel

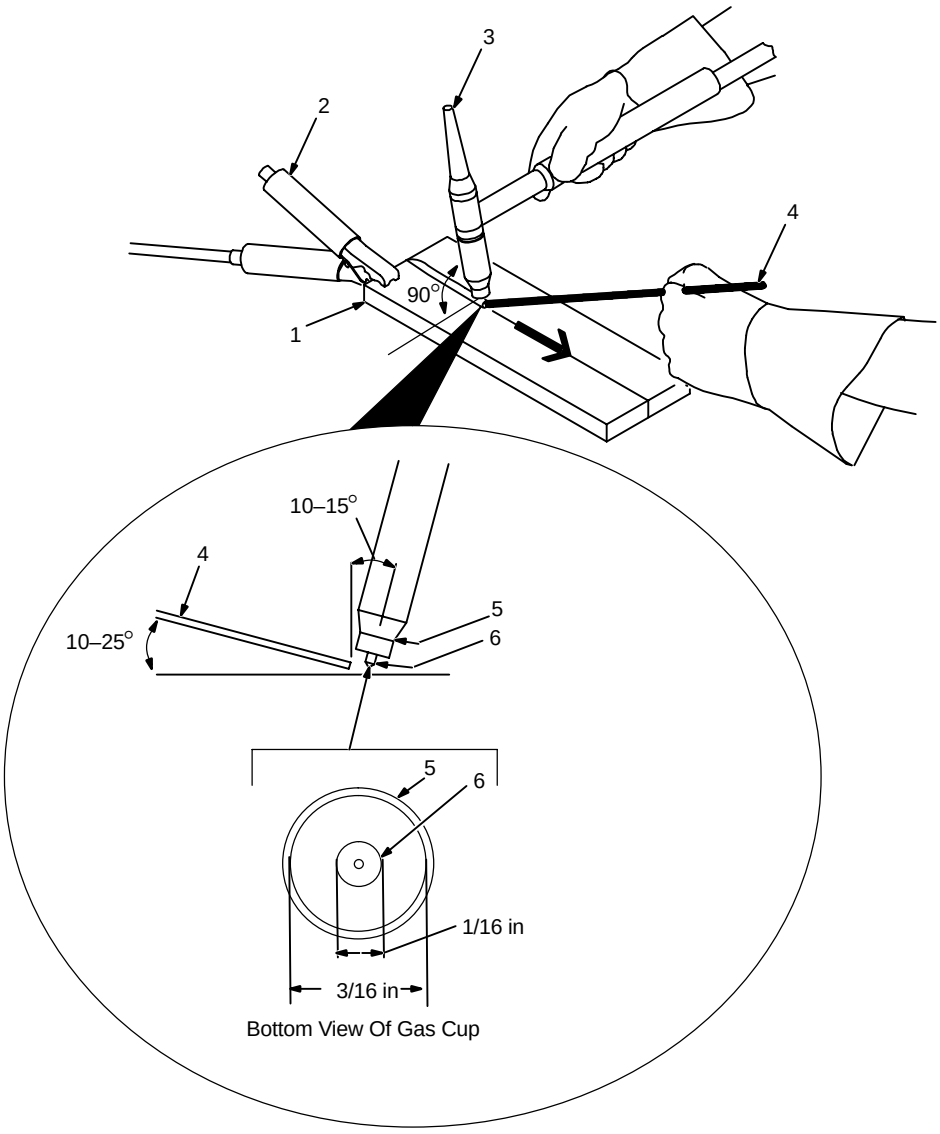
Grinding wheel should be dedicated to grinding tungsten only.

4 Radial Ground

Ref. S-0161 / Ref. S-0162

SECTION 9 – GUIDELINES FOR TIG WELDING (GTAW)

9-1. Positioning The Torch



Bottom View Of Gas Cup

▲ **Grinding the tungsten electrode produces dust and flying sparks which can cause injury and start fires. Use local exhaust (forced ventilation) at the grinder or wear an approved respirator. Read MSDS for safety information. Consider using cerium or lanthanum based tungsten instead of thoriated. Thorium dust contains low-level radioactive material. Properly dispose of grinder dust in an environmentally safe way. Wear proper face, hand, and body protection. Keep flammables away.**

1 Workpiece

Make sure workpiece is clean before welding.

2 Work Clamp

Place as close to the weld as possible.

3 Torch

4 Filler Rod (If Applicable)

5 Gas Cup

6 Tungsten Electrode

Select and prepare tungsten according to Section 8.

Guidelines:

The inside diameter of the gas cup should be at least three times the tungsten diameter to provide adequate shielding gas coverage. (For example, if tungsten is 1/16 in diameter, gas cup should be a minimum of 3/16 in diameter.

Tungsten extension is the distance the tungsten extends out gas cup of torch.

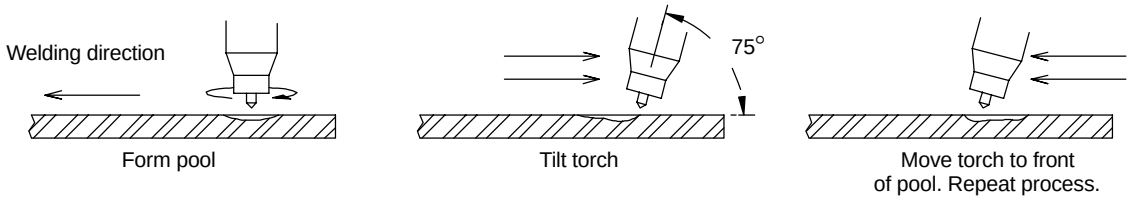
The tungsten extension should be no greater than the inside diameter of the gas cup.

Arc length is the distance from the tungsten to the workpiece.

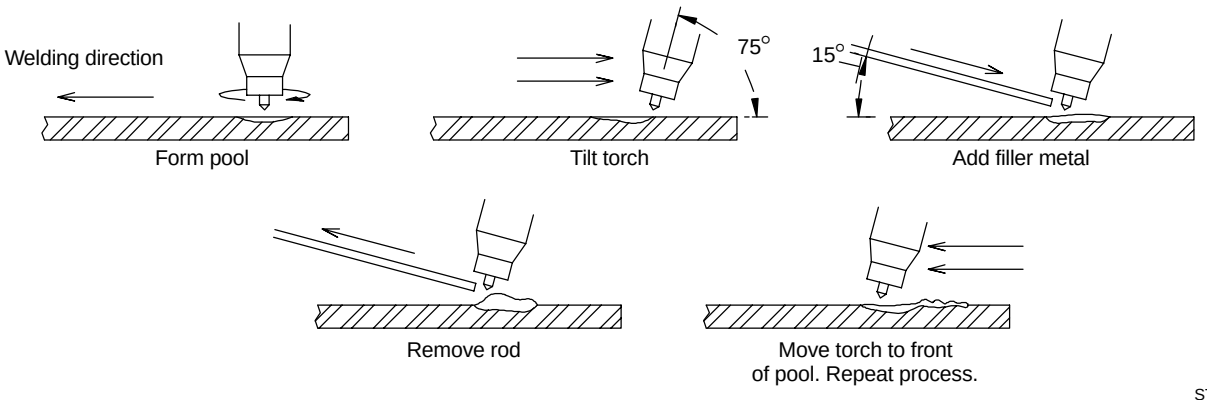
Ref. ST-161 892

9-2. Torch Movement During Welding

Tungsten Without Filler Rod



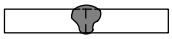
Tungsten With Filler Rod

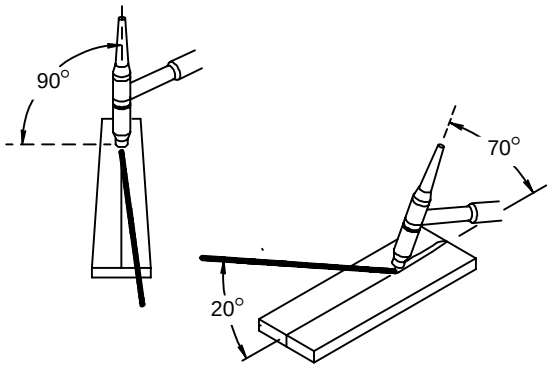


ST-162 002-B

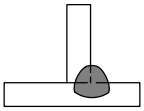
9-3. Positioning Torch Tungsten For Various Weld Joints

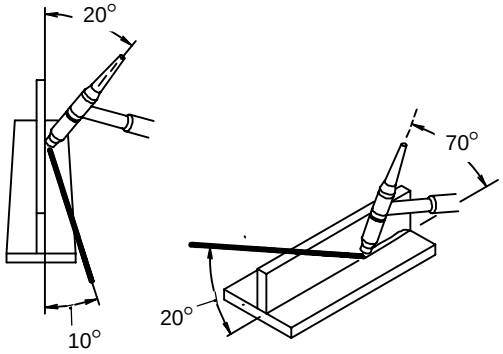
Butt Weld And Stringer Bead



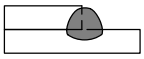


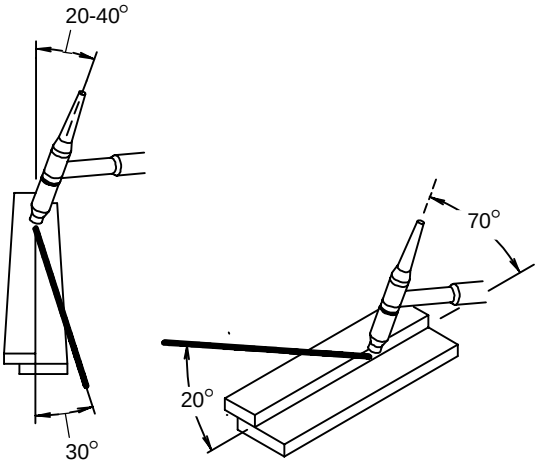
"T" Joint



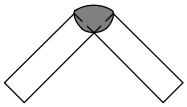


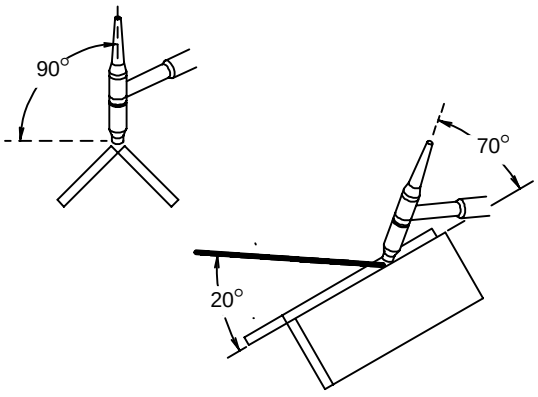
Lap Joint





Corner Joint

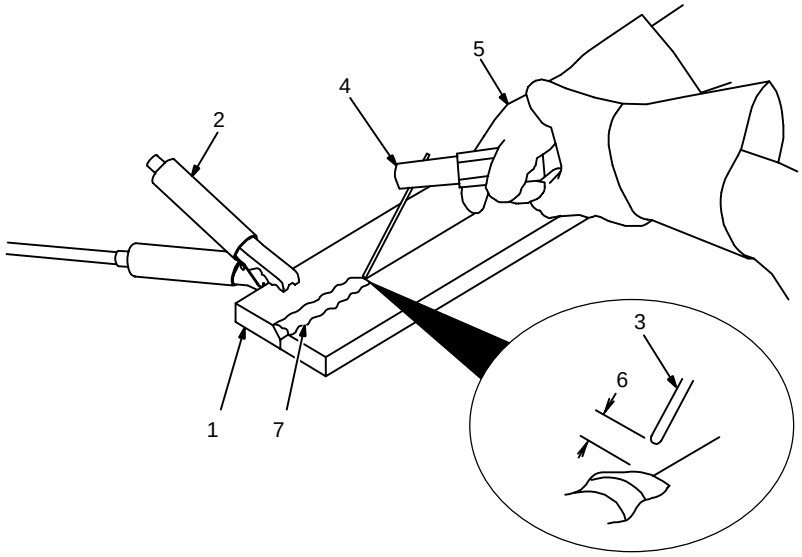




ST-162 003 / S-0792

SECTION 10 – STICK WELDING (SMAW) GUIDELINES

10-1. Stick Welding Procedure



▲ **Weld current starts when electrode touches workpiece.**

▲ **Weld current can damage electronic parts in vehicles. Disconnect both battery cables before welding on a vehicle. Place work clamp as close to the weld as possible.**

1 Workpiece

Make sure workpiece is clean before welding.

2 Work Clamp

3 Electrode

A small diameter electrode requires less current than a large one. Follow electrode manufacturer's instructions when setting weld amperage (see Section 10-2).

4 Insulated Electrode Holder

5 Electrode Holder Position

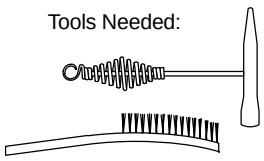
6 Arc Length

Arc length is the distance from the electrode to the workpiece. A short arc with correct amperage will give a sharp, crackling sound.

7 Slag

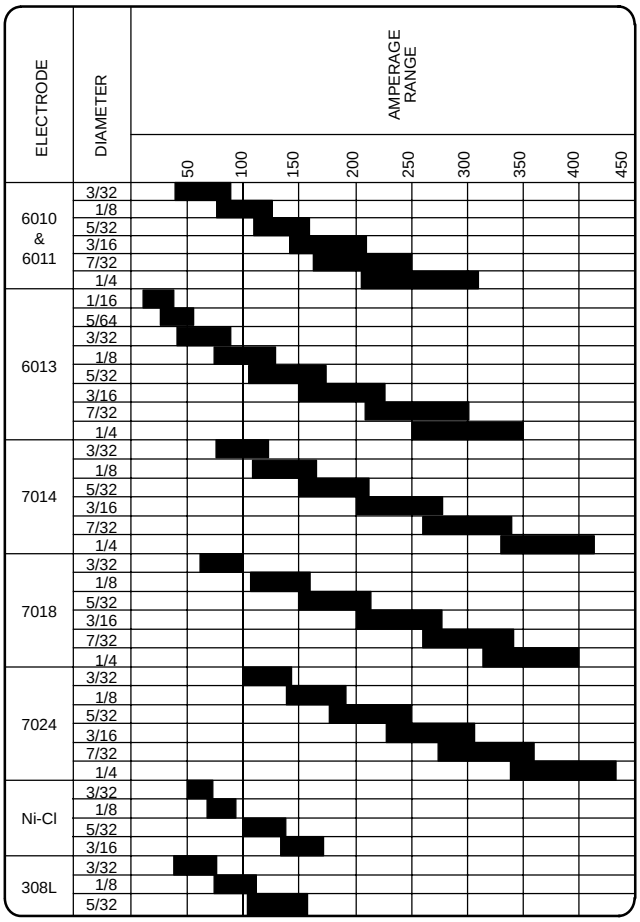
Use a chipping hammer and wire brush to remove slag. Remove slag and check weld bead before making another weld pass.

Tools Needed:



stick 12/96 – ST-151 593

10-2. Electrode and Amperage Selection Chart

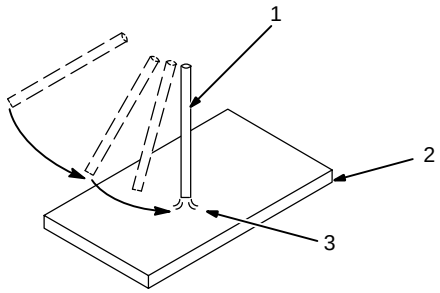


ELECTRODE	DC*	AC	POSITION	PENETRATION	USAGE
6010	EP		ALL	DEEP	MIN. PREP, ROUGH HIGH SPATTER
6011	EP	✓	ALL	DEEP	
6013	EP,EN	✓	ALL	LOW	GENERAL
7014	EP,EN	✓	ALL	MED	SMOOTH, EASY, FAST
7018	EP	✓	ALL	LOW	LOW HYDROGEN, STRONG
7024	EP,EN	✓	FLAT HORIZ FILLET	LOW	SMOOTH, EASY, FASTER
NI-CL	EP	✓	ALL	LOW	CAST IRON
308L	EP	✓	ALL	LOW	STAINLESS

*EP = ELECTRODE POSITIVE (REVERSE POLARITY)
EN = ELECTRODE NEGATIVE (STRAIGHT POLARITY)

Ref. S-087 985-A

10-3. Striking an Arc – Scratch Start Technique

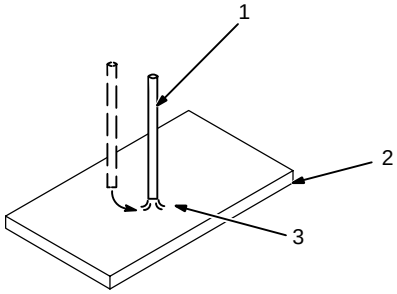


1 Electrode
2 Workpiece
3 Arc

Drag electrode across workpiece like striking a match; lift electrode slightly after touching work. If arc goes out electrode was lifted to high. If electrode sticks to workpiece, use a quick twist to free it.

S-0049

10-4. Striking an Arc – Tapping Technique

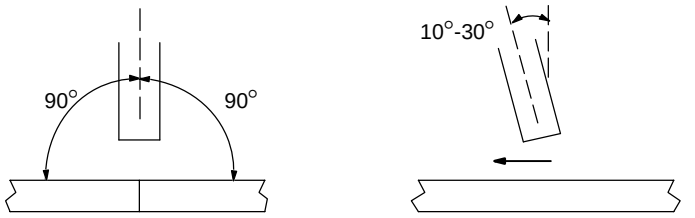


1 Electrode
2 Workpiece
3 Arc

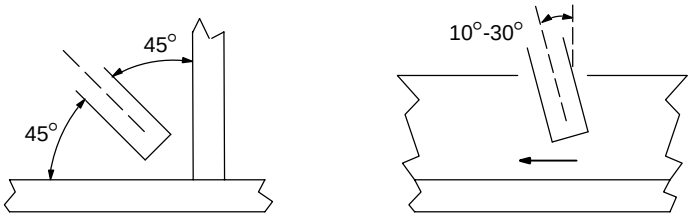
Bring electrode straight down to workpiece; then lift slightly to start arc. If arc goes out, electrode was lifted too high. If electrode sticks to workpiece, use a quick twist to free it.

S-0050

10-5. Positioning Electrode Holder



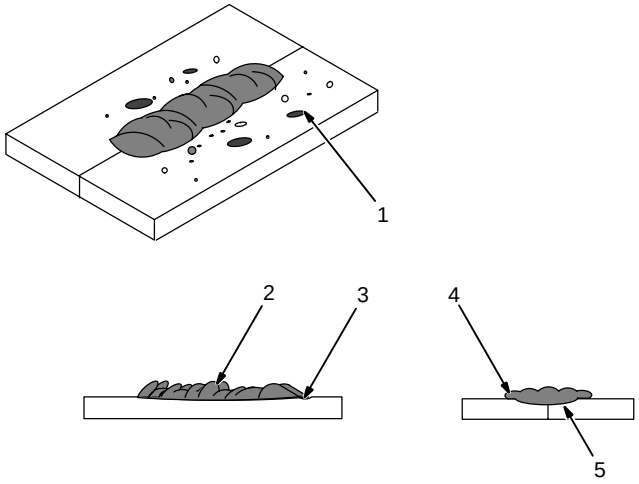
GROOVE WELDS



FILLET WELDS

S-0060

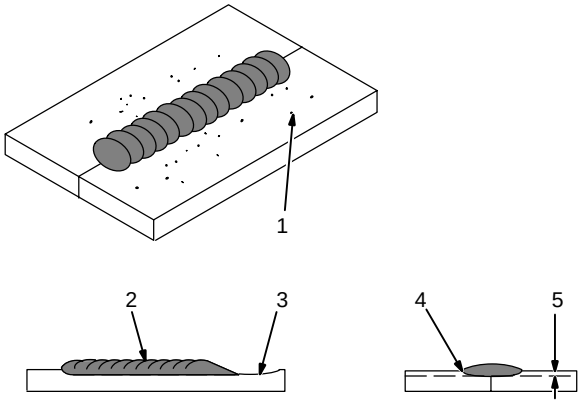
10-6. Poor Weld Bead Characteristics



1 Large Spatter Deposits
2 Rough, Uneven Bead
3 Slight Crater During Welding
4 Bad Overlap
5 Poor Penetration

S-0053-A

10-7. Good Weld Bead Characteristics



1 Fine Spatter
2 Uniform Bead
3 Moderate Crater During Welding

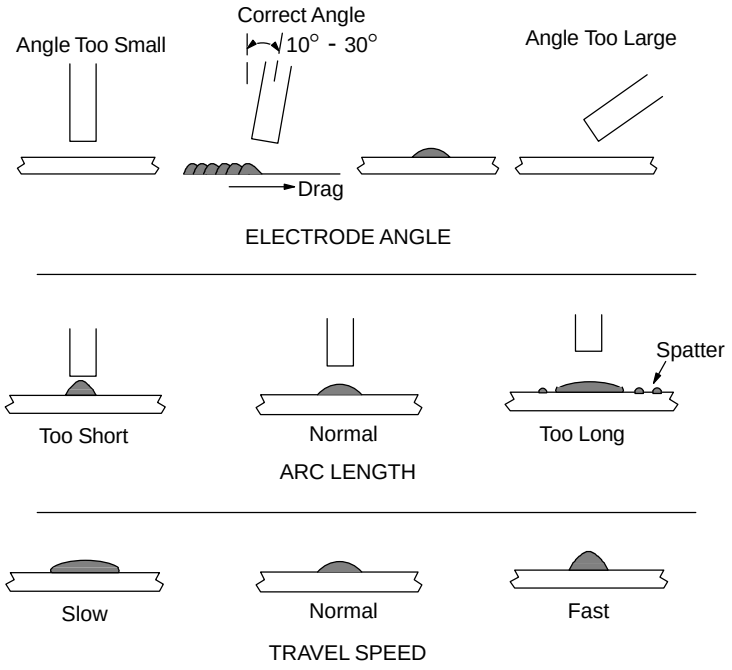
Weld a new bead or layer for each 1/8 in. (3.2 mm) thickness in metals being welded.

4 No Overlap
5 Good Penetration into Base Metal

S-0052-B

10-8. Conditions That Affect Weld Bead Shape

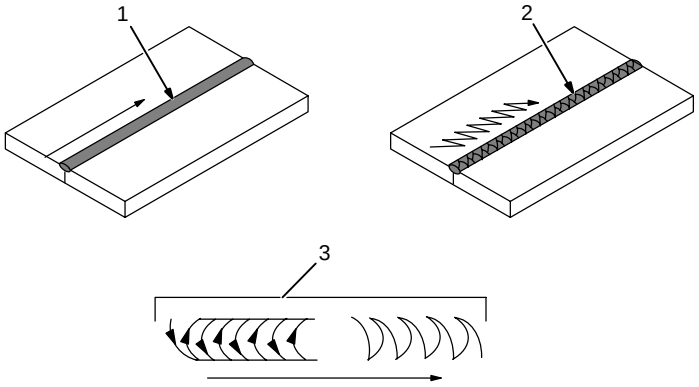
NOTE ☞ *Weld bead shape is affected by electrode angle, arc length, travel speed, and thickness of base metal.*



S-0061

10-9. Electrode Movement During Welding

NOTE ☞ *Normally, a single stringer bead is satisfactory for most narrow groove weld joints; however, for wide groove weld joints or bridging across gaps, a weave bead or multiple stringer beads work better.*



1 Stringer Bead – Steady Movement Along Seam

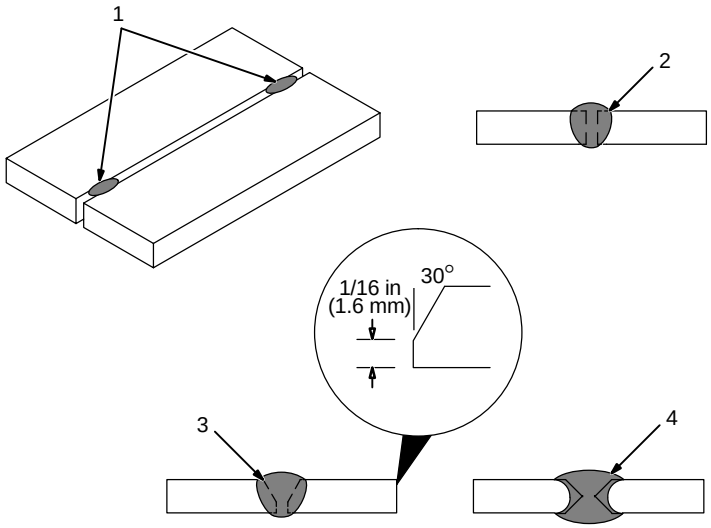
2 Weave Bead – Side to Side Movement Along Seam

3 Weave Patterns

Use weave patterns to cover a wide area in one pass of the electrode. Do not let weave width exceed 2-1/2 times diameter of electrode.

S-0054-A

10-10. Butt Joints



1 Tack Welds

Prevent edges of joint from drawing together ahead of electrode by tack welding the materials in position before final weld.

2 Square Groove Weld

Good for materials up to 3/16 in (5 mm) thick.

3 Single V-Groove Weld

Good for materials 3/16 – 3/4 in (5-19 mm) thick. Cut bevel with oxy-acetylene or plasma cutting equipment. Remove scale from material after cutting. A grinder can also be used to prepare bevels.

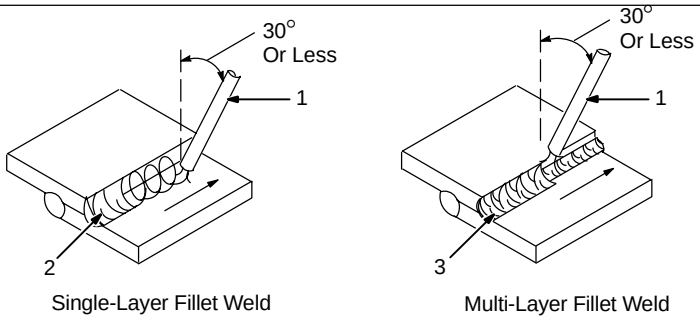
Create 30 degree angle of bevel on materials in V-groove welding.

4 Double V-Groove Weld

Good for materials thicker than 3/16 in (5 mm).

S-0662

10-11. Lap Joint



1 Electrode

2 Single-Layer Fillet Weld

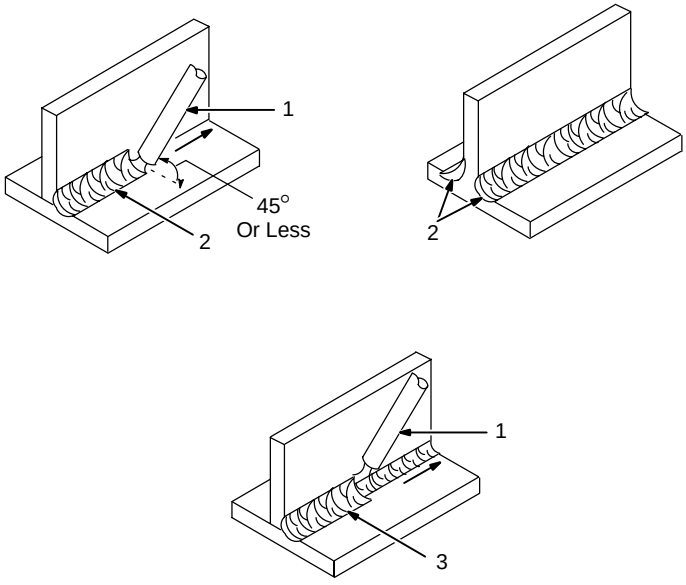
Move electrode in circular motion.

3 Multi-Layer Fillet Weld

Weld a second layer when a heavier fillet is needed. Remove slag before making another weld pass. Weld both sides of joint for maximum strength.

S-0063 / S-0064

10-12. Tee Joint



1 Electrode

2 Fillet Weld

Keep arc short and move at definite rate of speed. Hold electrode as shown to provide fusion into the corner. Square edge of the weld surface.

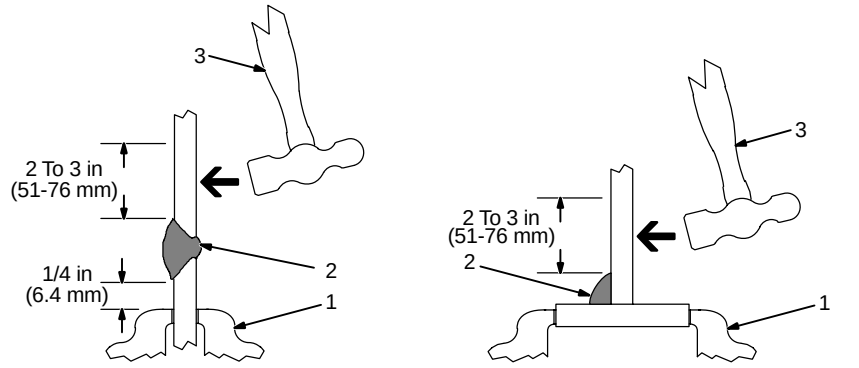
For maximum strength weld both sides of upright section.

3 Multi-Layer Deposits

Weld a second layer when a heavier fillet is needed. Use any of the weaving patterns shown in Section 10-9. Remove slag before making another weld pass.

S-0060 / S-0058-A / S-0061

10-13. Weld Test

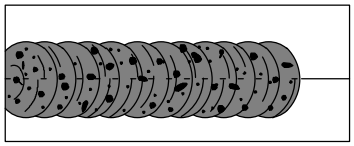


1 Vise
2 Weld Joint
3 Hammer

Strike weld joint in direction shown. A good weld bends over but does not break.

S-0057-B

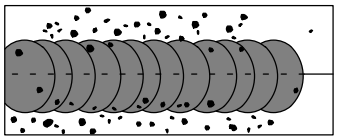
10-14. Troubleshooting – Porosity



Porosity – small cavities or holes resulting from gas pockets in weld metal.

Possible Causes	Corrective Actions
Arc length too long.	Reduce arc length.
Damp electrode.	Use dry electrode.
Workpiece dirty.	Remove all grease, oil, moisture, rust, paint, coatings, slag, and dirt from work surface before welding.

10-15. Troubleshooting – Excessive Spatter



Excessive Spatter – scattering of molten metal particles that cool to solid form near weld bead.

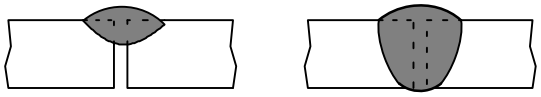
Possible Causes	Corrective Actions
Amperage too high for electrode.	Decrease amperage or select larger electrode.
Arc length too long or voltage too high.	Reduce arc length or voltage.

10-16. Troubleshooting – Incomplete Fusion

Incomplete Fusion – failure of weld metal to fuse completely with base metal or a preceeding weld bead.

Possible Causes	Corrective Actions
Insufficient heat input.	Increase amperage. Select larger electrode and increase amperage.
Improper welding technique.	Place stringer bead in proper location(s) at joint during welding.
	Adjust work angle or widen groove to access bottom during welding.
	Momentarily hold arc on groove side walls when using weaving technique.
	Keep arc on leading edge of weld puddle.
Workpiece dirty.	Remove all grease, oil, moisture, rust, paint, coatings, slag, and dirt from work surface before welding.

10-17. Troubleshooting – Lack Of Penetration

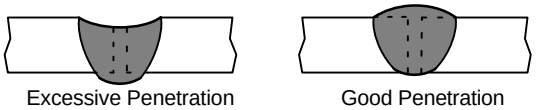


Lack of Penetration Good Penetration

Lack Of Penetration – shallow fusion between weld metal and base metal.

Possible Causes	Corrective Actions
Improper joint preparation.	Material too thick. Joint preparation and design must provide access to bottom of groove.
Improper weld technique.	Keep arc on leading edge of weld puddle.
Insufficient heat input.	Increase amperage. Select larger electrode and increase amperage.
	Reduce travel speed.

10-18. Troubleshooting – Excessive Penetration

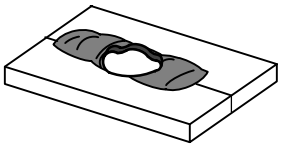


Excessive Penetration Good Penetration

Excessive Penetration – weld metal melting through base metal and hanging underneath weld.

Possible Causes	Corrective Actions
Excessive heat input.	Select lower amperage. Use smaller electrode.
	Increase and/or maintain steady travel speed.

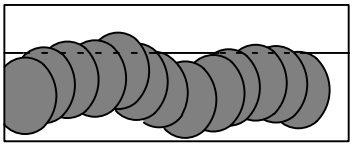
10-19. Troubleshooting – Burn-Through



Burn-Through – weld metal melting completely through base metal resulting in holes where no metal remains.

Possible Causes	Corrective Actions
Excessive heat input.	Select lower amperage. Use smaller electrode.
	Increase and/or maintain steady travel speed.

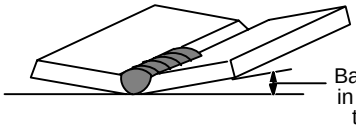
10-20. Troubleshooting – Waviness Of Bead



Waviness Of Bead – weld metal that is not parallel and does not cover joint formed by base metal.

Possible Causes	Corrective Actions
Unsteady hand.	Use two hands. Practice technique.

10-21. Troubleshooting – Distortion



Distortion – contraction of weld metal during welding that forces base metal to move.

Possible Causes	Corrective Actions
Excessive heat input.	Use restraint (clamp) to hold base metal in position.
	Make tack welds along joint before starting welding operation.
	Select lower amperage for electrode.
	Increase travel speed.
	Weld in small segments and allow cooling between welds.

Notes

SECTION 11 – PARTS LIST

☞ *Hardware is common and not available unless listed.*

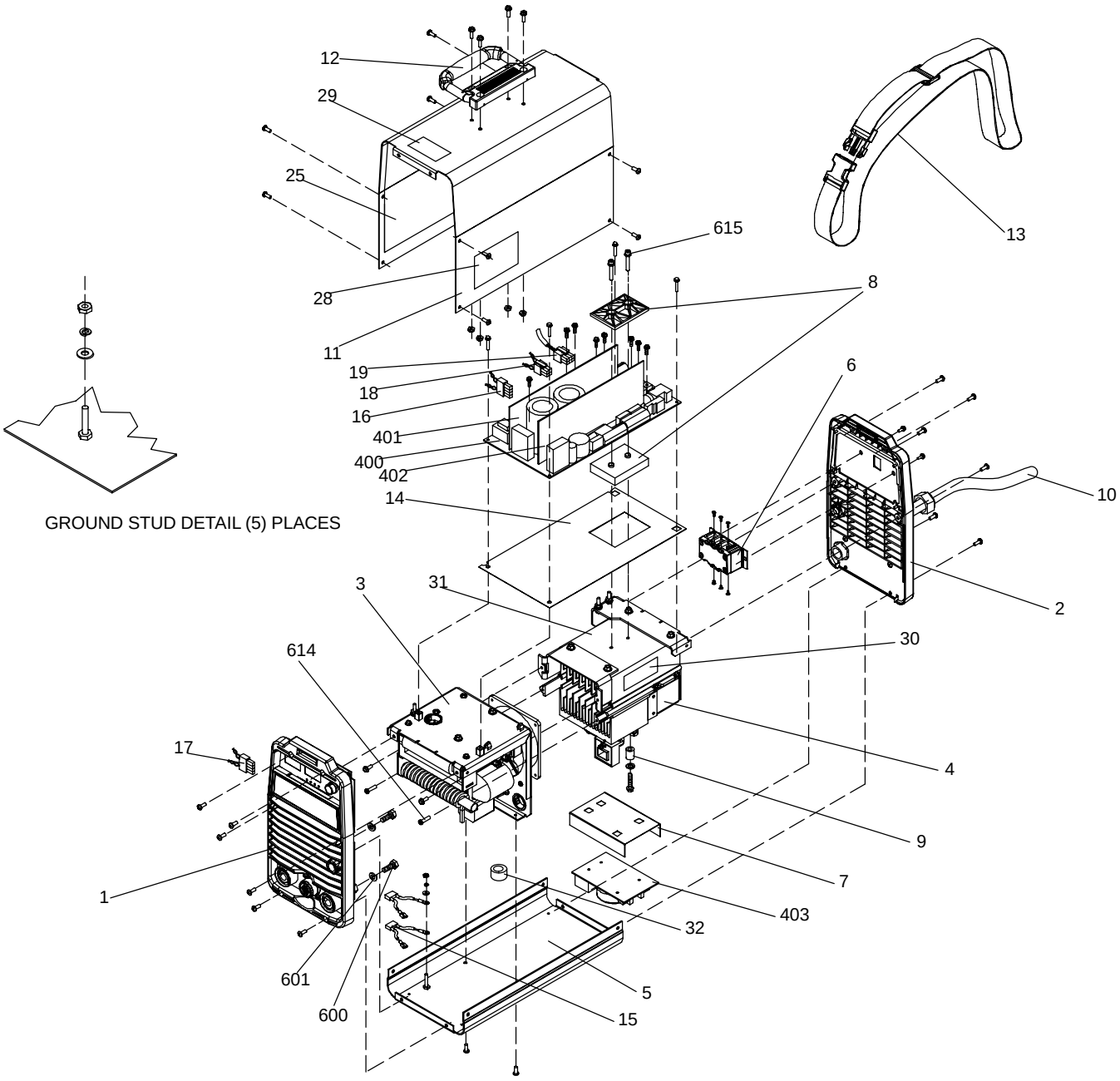


Figure 11-1. Main Assembly

803 227

Item No.	Dia. Mkgs.	Part No.	Description	Quantity

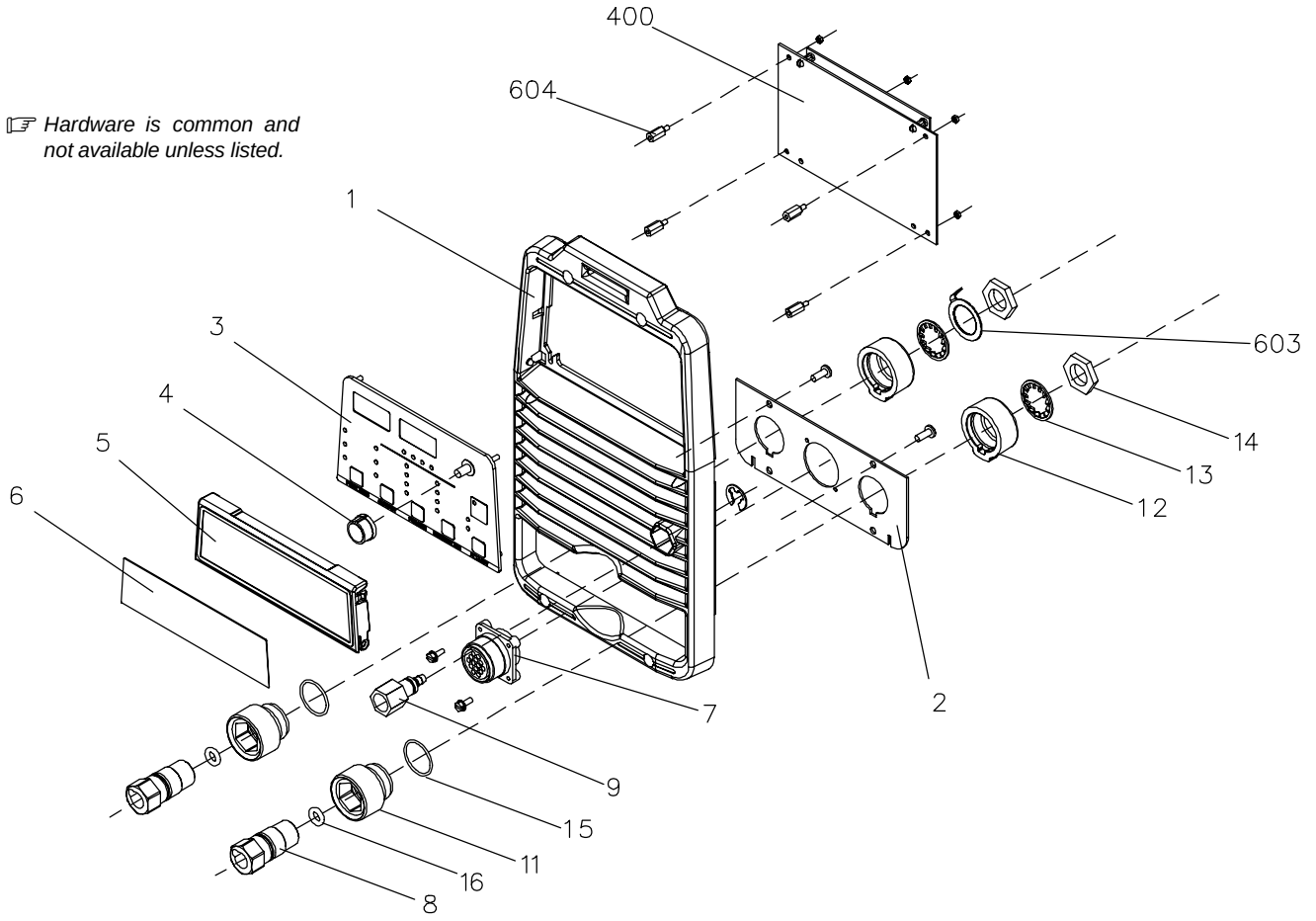
Figure 11-1. Main Assembly

1		Fig11-2	Panel, Front W/Cmpnt	1
2		Fig11-3	Panel, Rear W/Cmpnt	1
3		Fig11-4	Magnetics Subassembly	1
4		Fig11-5	Windtunnel, W/Components	1
5		Fig11-7	Base Assy,	1
6	S1	128756	Switch, Tgl 3pst 40a 600vac Scr Term Wide Tgl	1
7		200393	Insulator, filter board (CE models only)	1
8	PM1	204821	Kit, Input/Pre-Regulator Inverter	1
9		049611	Tubing, Cop .540 Od X .123 Wall X .687	1
10		196727	Cable, Power 10 Ft 12ga 4c Blk/Red/Wht/Grnyel	1
11		+195643	Wrapper,	1
12		206108	Handle, Rubberized Carrying	1
13		195663	Strap, Shoulder 6 Ft	1
14		189782	Insulator, Interconnect Board	1
15	C7, 8	186543	Capacitor Assy,	2
16		189778	Plug W/Leads, Vfb	1
17		189773	Plug W/Leads, Arc Starter	1
18		189768	Plug W/Leads, Gas	1
19		189779	Cable, Lem W/Plugs	1
25		189784	Insulator, wrapper	2
28		203990	Label, Warning General Precautionary (Non Ce Models)	2
28		179310	Label, Warning General Precautionary (Ce Models)	2
29		138442	Label, Caution Falling	1
30		185835	Label, Warning Electric Shock/Exploding Parts (Non Ce Models)	1
30		185836	Label, Warning Electric Shock/Exploding Parts (Ce Models)	1
31		185836	Label, GND/PE	1
32		207310	Core, Toroidal (CE Models)	1
400	PC2	200851	Circuit Card Assy, Power	1
401	PC1	206129	Circuit Card Assy, Inverter	1
402	PC10	200841	Circuit Card Assy, Boost	1
403		199506	Circuit Card Assy, Filter (CE Models Only)	1
600		186329	Screw, M10–1.5x 25 Hex Hd–pln 8.8 Pld	2
601		083883	Washer, Lock .402idx0.709odx.087t Stl Split10mm	2
614		136343	Screw, K50x 20 Pan Hd–phl Stl Pld Pt Thread Forming	2
615		200565	Screw, M 5–.8x 35 Soc Pan hd-phl Stl Pls Sems	4

+When ordering a component originally displaying a precautionary label, the label should also be ordered.

To maintain the factory original performance of your equipment, use only Manufacturer's Suggested Replacement Parts.

Model and serial number required when ordering parts from your local distributor.



☞ *Hardware is common and not available unless listed.*

Ref. 199 491-A

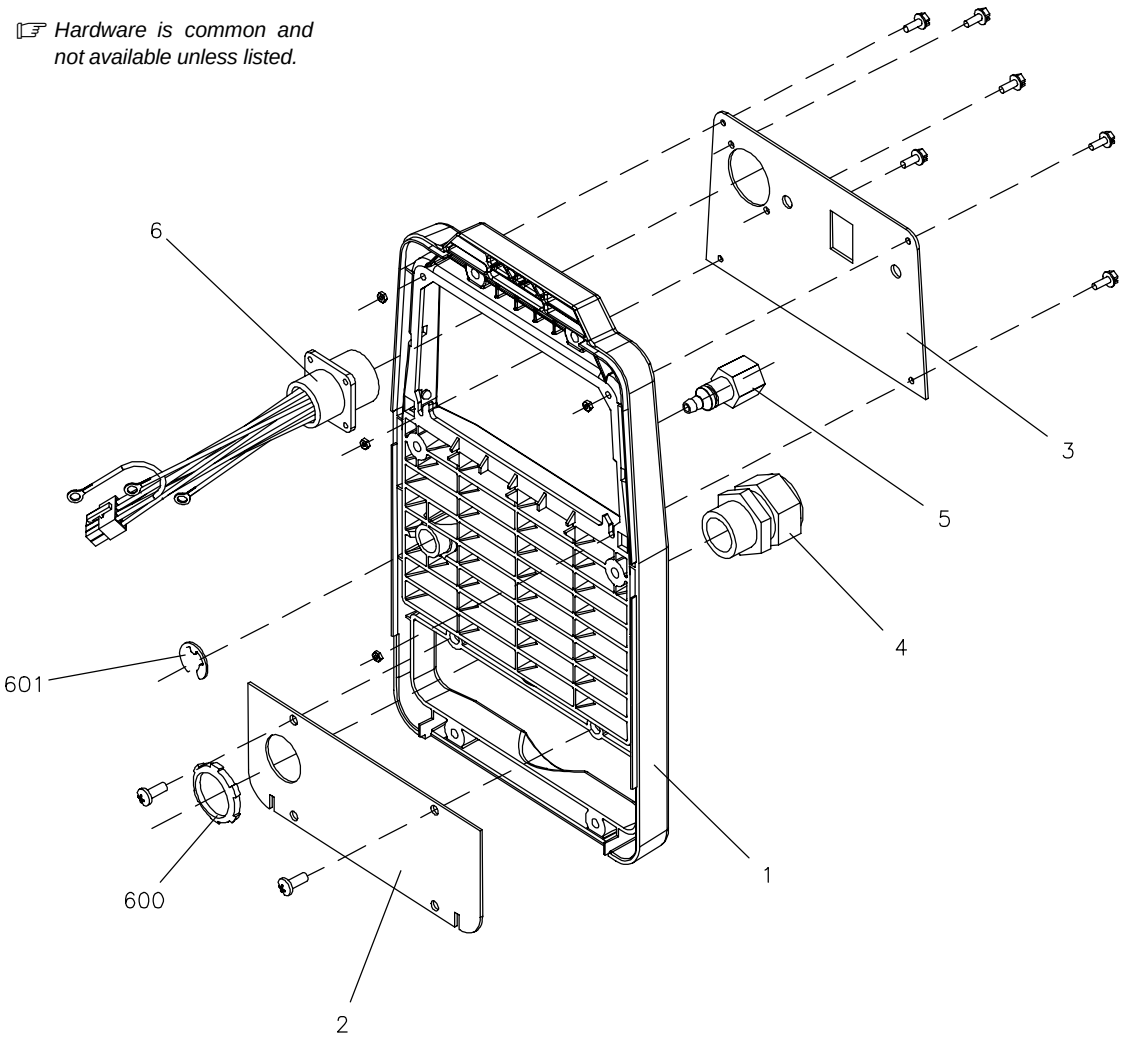
Figure 11-2. Panel, Front w/Components

Item No.	Dia. Mkgs.	Part No.	Description	Quantity
			11-2. Panel, Front w/Components (Figure 11-1 Item 1)	
1		194242	Panel, Front/Rear	1
2		195647	Panel, Front Lower	1
3		192884	Nameplate/Switch Membrane, Maxstar DX & LX (Non CE Models)	1
3		192886	Nameplate/Switch Membrane, Maxstar SD (Non CE Models)	1
3		192888	Nameplate/Switch Membrane, Maxstar DX & LX (CE Models)	1
3		192890	Nameplate/Switch Membrane, Maxstar SD (CE Models)	1
4		174992	Knob, Pointer .840 Dia X .250 Id W/Spring Clip–.21	1
5		194243	Door,	1
6		199008	Label, Door Maxstar 200 SD	1
6		199009	Label, Door Maxstar 200 DX	1
6		199010	Label, Door Maxstar 200 LX	1
7	RC1	189771	Receptacle W/Leads & Plug (14 Pin)	1
8		202553	Rcpt, Tw Lk Insul Fem(Dinse Type)50/70 Series Wsl	2
9		193649	Ftg, Gas Barbed 1/4 TBG 5/8–18 Female	1
9		193650	Ftg, Gas Barbed 1/4 TBG 3/8–19 BSPP Male (CE Models Only)	1
11		185712	Insulator, Bulkhead Front	2
12		185713	Insulator, Bulkhead Rear	2
13		185714	Washer, Tooth 20MM I.D. X 32MM O.D.	2
14		185717	Nut, M20 X 1.5 1.0625 Hex .19 H Locking	2
15		185718	O-Ring 0.989 I.D. X 0.070 Wall	2
16		186228	O-Ring 0.739 I.D. X 0.070 Wall	2
400	PC3	208315	Circuit Card Assy, Weld Control (SD & DX Models Only)	1
400	PC3	208317	Circuit Card Assy, Weld Control (LX Models Only)	1
		186 914	LED, red 5.0V 20MA RH DEC 7seg ALGAAS com anode	6

Item No.	Dia. Mkgs.	Part No.	Description	Quantity
			11-2. Panel, Front w/Components (Figure 11-1 Item 1) (continued)	
601		106702	Nut, 006–32 .31hex .20hex .20h Stl Pld (CE Models Only)	4
602		166560	Ring, Rtng Ext .500 Shaft X .042 Thk E Style Bowed	1
603		178548	Terminal, Connector Friction	1
604		098691	Stand–off, No 6–32 X .500 Lg .250 Hex Stl M&f	4
606		605568	Washer, Flat .140ID x 0.437OD x .04 (CE Models Only)	4
607		201623	Nut, M08-1.0 13MM Hex 4MMT Jam (CE Models Only)	1
608		602211	Washer, Lock .318ID x 0.586OD x .07 (CE Models Only)	1
609		201624	Washer, Flat .342ID x .751OD (CE Models Only)	1

To maintain the factory original performance of your equipment, use only Manufacturer's Suggested Replacement Parts. Model and serial number required when ordering parts from your local distributor.

☞ *Hardware is common and not available unless listed.*



Ref. 199 492

Figure 11-3.Panel, Rear w/Components

Item No.	Dia. Mkgs.	Part No.	Description	Quantity

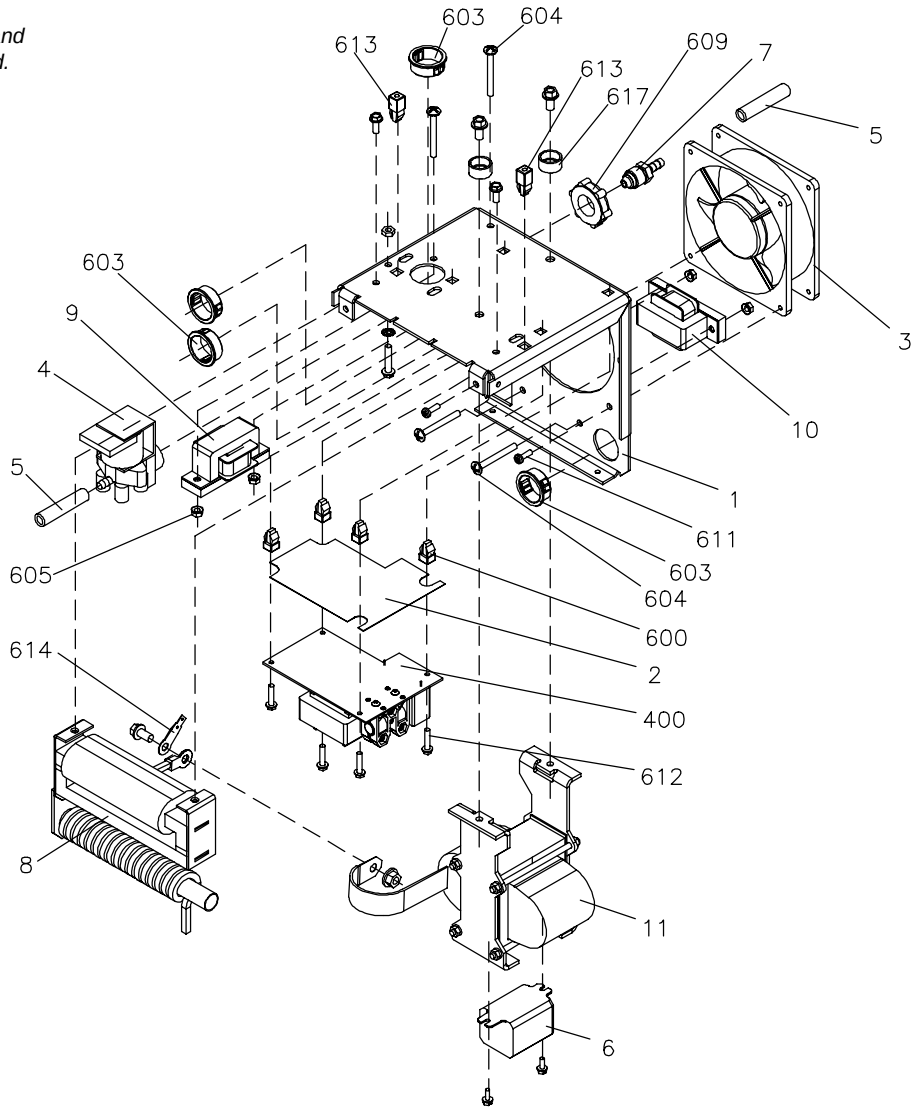
Figure 11-3. Panel, Rear w/Components (Figure 11-1 Item 2)

1	194242	Panel, Front/Rear	1
2	195648	Panel, Rear Lower	1
3	195646	Panel, Rear Upper (SD & DX Models Only)	1
3	197127	Panel, Rear Upper 10-pin (LX Models Only)	1
4	186440	Bushing, Strain Relief .350/ .630 ID X1.050 Mtg Hol	1
4	201155	Bushing, Strain Relief .450/ .709 ID X1.608 Mtg Hol (CE Models Only)	1
5	193649	Ftg, Gas Barbed 1/4 TBG 5/8–18 Female	1
5	193650	Ftg, Gas Barbed 1/4 TBG 3/8–19 BSPP Male (CE Models Only)	1
6	199882	Receptacle, W/Leads 4 Plug 10-pin (LX Models Only)	1
	146 212	Conn, Circ Ms/Met 10Pin Sz 18 Plug Cable Solder (LX Models Only)	1
	073 332	Conn, Circ Ms/Met Clamp Str Rlf Sz 18 (LX Models Only)	1
600	198245	Nut, Conduit .750 Npt Pld 1.388 Od X .150 Thk	1
601	166560	Ring, Rtng Ext .500 Shaft X .042 Thk E Style Bowed	1
601	201623	Nut, M08-1.0 13MM Hex 4MMT Jam (CE Models Only)	1
605	201624	Washer, Flat .342ID x .751OD .060 BRS (CE Models Only)	1
606	602211	Washer, Lock .318ID x 0.586OD x .07 (CE Models Only)	1

+When ordering a component originally displaying a precautionary label, the label should also be ordered.

To maintain the factory original performance of your equipment, use only Manufacturer's Suggested Replacement Parts. Model and serial number required when ordering parts from your local distributor.

☞ *Hardware is common and not available unless listed.*



Ref. 199 501

Figure 11-4. Magnetics Assembly w/Components

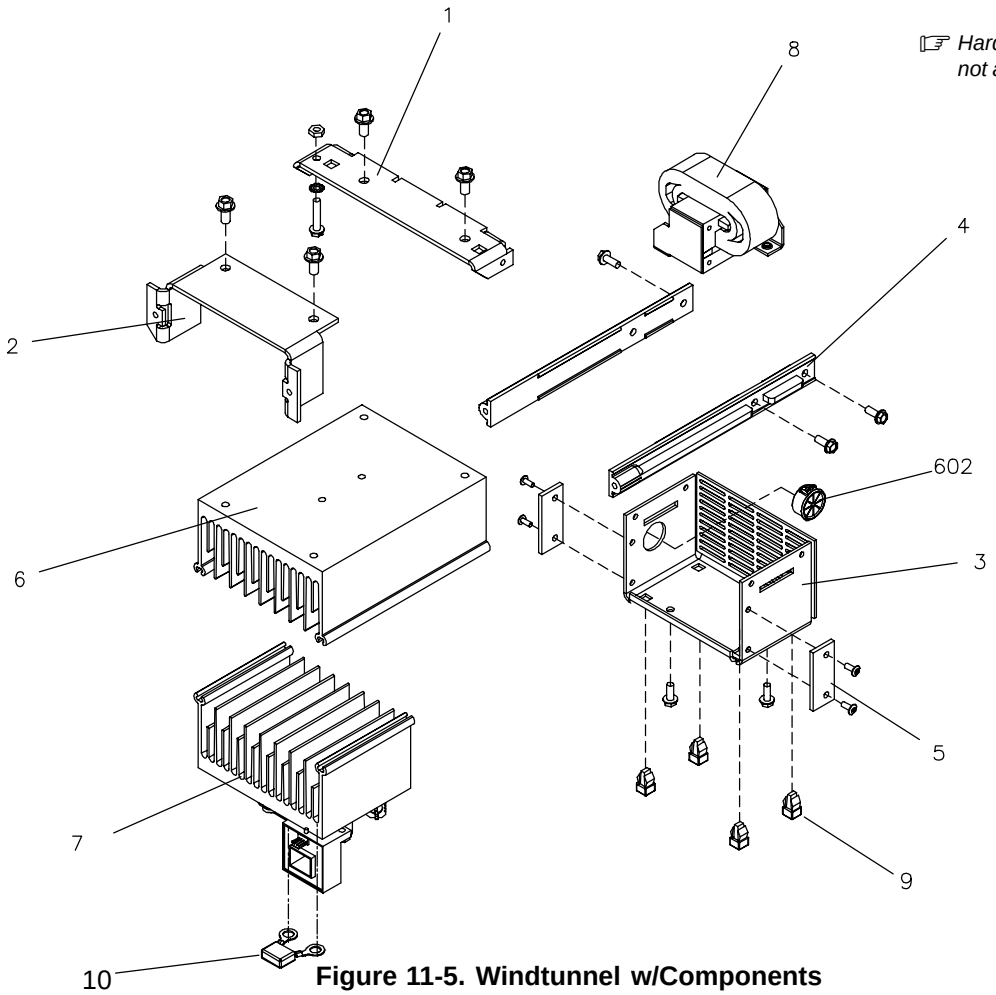
Item No.	Dia. Mkgs.	Part No.	Description	Quantity
			Figure 11-4. Magnetics Assembly w/Components (Figure 11-1 Item 3)	
1		195649	Panel, Plenum	1
2		189785	Insulator, Hf Coil	1
3	FM1	196887	Fan, Muffin 24vdc 3000 Rpm 130 Cfm 4.125 Mtg Holes	1
4	GS1	133873	Valve, 24vdc 2way Custom Port 1/8 Orf W/Frict	1
5		197987	Hose, Nprn Brd No 1 X .250 Id X 10.000	2
6	CR1	198549	Relay, Encl 24vdc Spst 35a/300vac 4pin Flange Mtg	1
7		112863	Ftg, Hose Brs Barbed M 1/4 Tbg X 5/8–18 Sae Flare	1
8		196443	Choke, Output And Coupling Coil Assy	1
9	L2	189870	Choke, Line 10uh 17a	1
10	L3	206020	Coil, inductor 14T	1
11	T1	189795	Xfmr, Power	1
12		109056	Core, Ferrite E 2.164 Lg X 1.094 High X .826 Wide	2
13		196512	Bracket, Inductor Mounting	2
14		196514	Gasket, Inductor Mounting	2
400	PC7	189939	Circuit Card Assy, Arc Starter	1
600		199538	Grommet, Scr No 8/10 Panel Hole .281 Sq .250 High	4

Item No.	Dia. Mkgs.	Part No.	Description	Quantity

Figure 11-4. Magnetics Assembly w/Components (Figure 11-1 Item 3) (Continued)

603	057357	Bushing, Snap–in Nyl .937 Id X 1.125 Mtg Hole	4
604	182737	Screw, 010–32x2.00 Rnd Hd–slt Brs Pln	4
609	605227	Nut, 750–14 Knurled1.68dia .41h Nyl	1
611	136343	Screw, K50x 20 Pan Hd–phl Stl Pld Pt Thread Forming	2
612	099273	Screw, 008–18x .62 Pan Hd–phl Stl Pld Sht Met A	4
613	083147	Grommet, Scr No 8/10 Panel Hole .312 Sq .500 High	2
614	010381	Connector, Rectifier	1
617	181853	Insulator, Screw	2

To maintain the factory original performance of your equipment, use only Manufacturer's Suggested Replacement Parts. Model and serial number required when ordering parts from your local distributor.



☞ *Hardware is common and not available unless listed.*

Ref. 199 494

Figure 11-5. Windtunnel w/Components

Item No.	Dia. Mkgs.	Part No.	Description	Quantity
			Figure 11-5. Windtunnel w/Components (Figure 11-1 Item 4)	
1		195645	Panel, Midplain Horizontal	1
2		198634	Bracket, Front Heatsink Mtg	1
3		198633	Wind Tunnel	1
4		189777	Rail, Heat Sink	2
5		198652	Bracket, Windtunnel Insulator	2
6		+192450	Heat Sink, Module	1
7		199497	Heat Sink, Secondary Assembly	1
8	L1	189787	Choke, Input	1
9		199538	Grommet, Scr No 8/10 Panel Hole .281 Sq .250 High (CE Models Only)	4
10	C9	151328	Capacitor, Polyp Met Film .0047Uf 1000 Vdc W/T (CE Models Only)	1
602		154408	Bushing, Snap–in Nyl .562 Id X .875 Mtg Hole Cent	1

+When ordering a component originally displaying a precautionary label, the label should also be ordered.

To maintain the factory original performance of your equipment, use only Manufacturer's Suggested Replacement Parts. Model and serial number required when ordering parts from your local distributor.

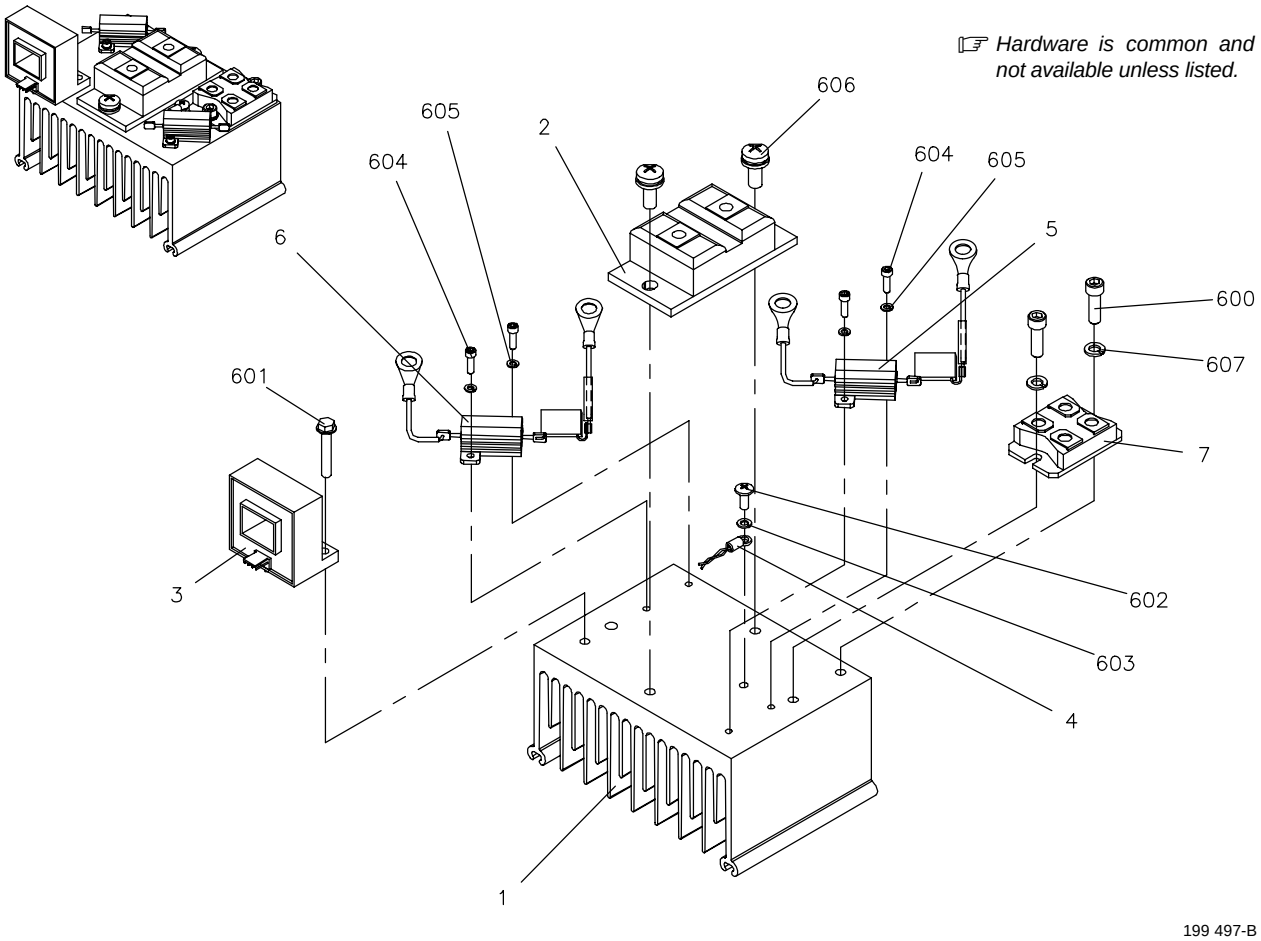
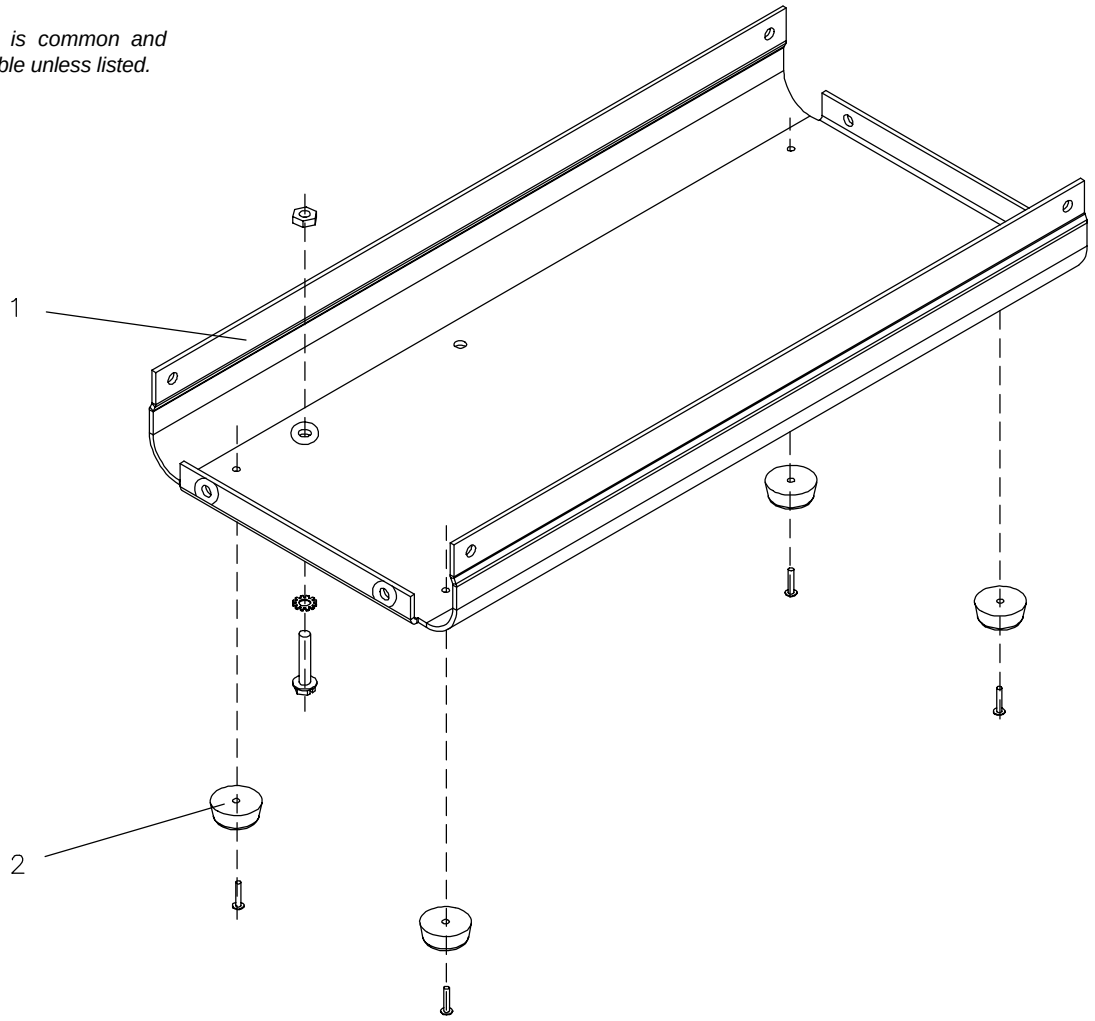


Figure 11-6. Heat Sink, Secondary Assembly

Item No.	Dia. Mkgs.	Part No.	Description	Quantity
			Figure 11-6. Heat Sink, Secondary Assembly (Figure 11-5 Item 7)	
1		206023	Heat Sink, Diode	1
2	D1	204820	Kit, Diode, Ultra Fast	1
3	HD1	198028	Transducer, Current 100a Module Supply V+/– 15v	1
4	RT1	199798	Thermistor, Ntc 30k Ohm @ 25 Deg C 18 in Lead	1
5	R2, C6	206021	Resistor/Capacitor,	1
6	R1, C5	199138	Resistor/Capacitor,	1
7	SR1	199952	Diode, Power Module 50 Amp 600V	1
600		143360	Screw, 008–32x .50 Pan Hd–Phl Stl Pld	2
601		129351	Screw, 008–32x .50 Hexwhd.34d Stl Pld Slffmg Tap–rw	1
602		138022	Screw, 006–32x .37 Pan Hd Phl Stl Pld Slf Fmg	1
603		602198	Washer, Lock .141idx0.250odx.031t Stl Pld Split #6	1
604		156579	Screw, 004–40x .37 Soc Hd–hex Stl Pld	4
605		156580	Washer, Lock .114idx0.209odx.025t Stl Pld Split #4	4
606		196683	Screw, M 6–1.0x 16 Pan Hd–phl Stl Pld Sems	2
607		602200	Washer, lock .168 ID x .277 OD x .04	2

To maintain the factory original performance of your equipment, use only Manufacturer's Suggested Replacement Parts. Model and serial number required when ordering parts from your local distributor.

☞ *Hardware is common and not available unless listed.*



199 493

Figure 11-7. Base Assembly

Item No.	Dia. Mkgs.	Part No.	Description	Quantity

Figure 11-7. Base Assembly
(Figure 11-1 Item 5)

1	195644	Base,	1
2	019663	Mount, Nprn 15/16odx3/8rec 3/16x3/8	4

To maintain the factory original performance of your equipment, use only Manufacturer's Suggested Replacement Parts. Model and serial number required when ordering parts from your local distributor.

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1. 5 Years Parts – 3 Years Labor
   * Original main power rectifiers
   * Inverters (input and output rectifiers only)
2. 3 Years — Parts and Labor
   * Transformer/Rectifier Power Sources
   * Plasma Arc Cutting Power Sources
   * Semi-Automatic and Automatic Wire Feeders
   * Inverter Power Supplies
   * Intellitig
   * Engine Driven Welding Generators **(NOTE: Engines are warranted separately by the engine manufacturer.)**
3. 1 Year — Parts and Labor
   * DS-2 Wire Feeder
   * Motor Driven Guns (w/exception of Spoolmate Spoolguns)
   * Process Controllers
   * Positioners and Controllers
   * Automatic Motion Devices
   * RFCS Foot Controls
   * Induction Heating Power Sources
   * Water Coolant Systems
   * HF Units
   * Grids
   * Maxstar 140
   * Spot Welders
   * Load Banks
   * Miller Cyclomatic Equipment
   * Running Gear/Trailers
   * Plasma Cutting Torches (except APT & SAF Models)
   * Field Options
     (NOTE: Field options are covered under True Blue® for the remaining warranty period of the product they are installed in, or for a minimum of one year — whichever is greater.)
4. 6 Months — Batteries
5. 90 Days — Parts
   * MIG Guns/TIG Torches
   * Induction Heating Coils and Blankets
   * APT, ZIPCUT & PLAZCUT Model Plasma Cutting Torches
   * Remote Controls
   * Accessory Kits
   * Replacement Parts (No labor)
   * Spoolmate Spoolguns
   * Canvas Covers

Miller's True Blue® Limited Warranty shall not apply to:

1. **Consumable components; such as contact tips, cutting nozzles, contactors, brushes, slip rings, relays or parts that fail due to normal wear.**
2. Items furnished by Miller, but manufactured by others, such as engines or trade accessories. These items are covered by the manufacturer's warranty, if any.
3. Equipment that has been modified by any party other than Miller, or equipment that has been improperly installed, improperly operated or misused based upon industry standards, or equipment which has not had reasonable and necessary maintenance, or equipment which has been used for operation outside of the specifications for the equipment.

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Purchase Date (Date which equipment was delivered to original customer.)

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